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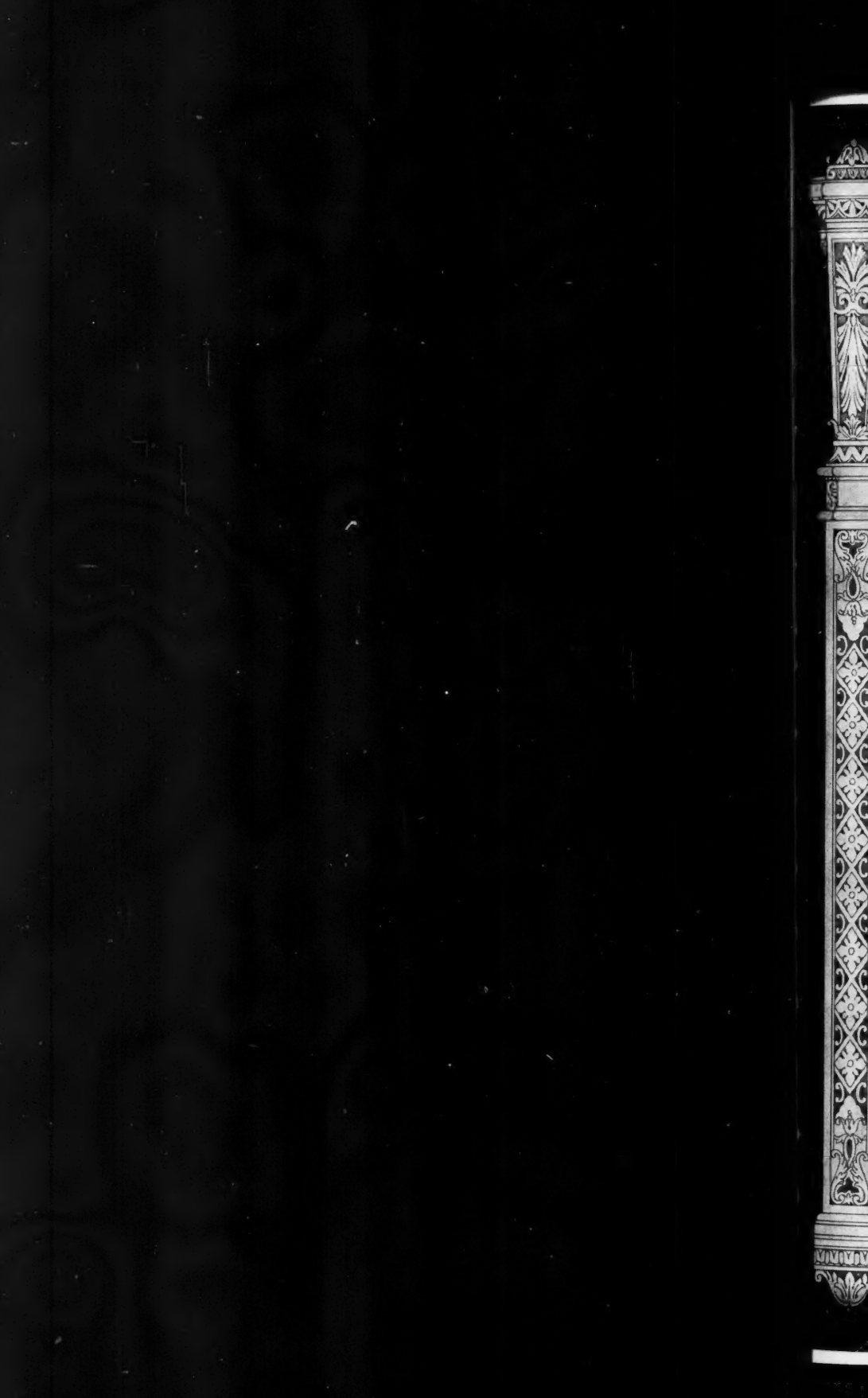

JANUARY

THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION

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Vice President of the American Dental Association

THE JOURNAL
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Vol. 19 JANUARY, 1932 No. 1

Original Communications

A PRACTICAL DISCUSSION OF BLOCK ANESTHESIA*

By HOWARD C. MILLER, D.D.S., F.A.C.D., Chicago, Ill.

IN dentistry, the general practitioner is often called on to render surgical service to patients who come to him seeking relief from pain or from some remote systemic disturbance which may be due to foci of infection in or around the teeth. To the average patient, the removal of a tooth is a simple procedure, an irksome but necessary part of the treatment for relief of his ailment, and as a rule he is not inclined to give much consideration to the possible serious consequences of the operation. This attitude has had much to do with the willingness of many dentists to proceed with the removal of teeth without giving due consideration to the case as a whole, and serious complications have resulted which might have been avoided by proper forethought.

That the dentist assumes this responsibility many times is due to his feeling that if he insists on complete examinations and reports, he will lessen his prestige in the eyes of his patient, that the patient may feel that much ado is being made over the simple matter of "having a tooth pulled," and his resentment may lead him to another dentist. A thorough knowledge of the principles involved in the removal of teeth, and a proper confidence in his own ability, will help the general practitioner to avoid any such misunderstanding.

It is not the intent of this paper to endeavor to classify as a major surgical operation the removal of every tooth, but to present briefly a few of the important phases that should be considered, and which necessarily must be considered before the proper anesthetic can be selected. In every case, the following should be given careful consideration: (1) diagnosis; (2) selection of anesthetic; (3)

*Read before the Section on Oral Surgery, Exodontia and Anesthesia at the Seventy-Third Annual Session of the American Dental Association, Memphis, Tenn., Oct. 20, 1931.

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operative procedure, and (4) postoperative care.

It must be remembered that diagnosis, the basis of all treatment, must be completed before the anesthetic can be selected or operative procedure can be undertaken. Many times, the extraction that appears most simple proves the most difficult, from the very fact that its apparent simplicity has led the dentist to proceed without proper consideration of all phases of the case.

Secondly, the patient is entitled to careful selection of the anesthetic, and while this paper will be confined to a practical discussion of block anesthesia, certain other considerations must precede the successful use of this valuable procedure.

No one anesthetic is suited to all cases or to all operations, and a decided preference for a certain method does not justify one in condemning the use of any other. It rests with each operator to judge, on the basis of his actual clinical experience, as to how he can best serve his patients and bring about the most satisfactory end-results. The successful operator selects the anesthetic best adapted to the case, the one through which the patient will receive the maximum benefit. The decision as to the anesthetic to be used should be based upon the physical condition and temperament of the patient, the type of operation and the personal choice of the one making the selection.

Nitrous oxid-oxygen has been recognized as a valuable aid to the general practitioner, and many men in general practice have enthusiastically purchased a highly developed apparatus. Owing to lack of training in the technic of administration of this anesthetic, difficulties of a more or less serious nature have been encountered, and quite frequently this very valuable adjunct to the dentist's armamentarium has been discarded and condemned by those who have had such experiences.

One should never accept the instruction of a demonstrator or salesman and attempt to produce anesthesia in a mechanical way, based upon regulators, timing appliances, etc. If the dentist desires to administer nitrous oxid-oxygen in his practice, he should train himself in the art of its administration; he should familiarize himself with the various signs and symptoms of anesthesia and be capable of meeting all conditions that may arise, not depending entirely on a mechanical device to produce and maintain normal anesthesia.

If the dentist is not willing to avail himself of a course of study in general anesthesia, it would be far better if he left the administration to others who have made such a study and are capable of administering nitrous oxid-oxygen in the proper way.

Block anesthesia has been widely used, and, in its various forms, has attained its rightful place among accepted dental procedures. Although it is extensively used with almost complete safety and success, the responsibilities even in so apparently simple a procedure are just as great as in the use of general anesthesia, and should never be minimized. Successful administration in block anesthesia involves careful application of its fundamental principles in each case, these principles comprising diagnosis, scrupulous asepsis, selection of the proper anesthetic, thorough knowledge of the anatomy of the parts involved and an exact technic.

DIAGNOSIS

Before the selection of a local anesthetic, the operator should make a careful study of the case. He must determine the

actual conditions as they arise and make his decision regarding procedure before beginning operation; thereby, as stated before, making diagnosis, for which the dentist is usually not paid, the most important service in dentistry. The operator recognizes better than anyone else possibly could his own abilities and his own limitations. He should never undertake a surgical procedure in which he is not absolutely certain of his ability to complete the case, barring, of course, those accidents which are liable to occur in any endeavor.

In dealing with acute types of dental infection, great care must be exercised in the use of a local anesthetic, as even in the early stages the extent of tissue involvement and the virulence of the organism are unknown factors. Treatment of these infections should be the same as for infection elsewhere in the body—regulation of the inflammatory process with a diffusion of the infection wherever possible and sufficient drainage when necessary.

Oftentimes, the general practitioner is called on to treat an acute alveolar abscess which has extended so as to involve the periosteum and surrounding tissue. In such cases, before any attempt is made to remove the cause under a local anesthetic, adequate drainage should be maintained for a sufficient time to enable the resisting process to combat the infection and restore the tissues to a normal condition.

If the infection has not extensively involved the adjoining structures, and only a local anesthetic is available to the operator, deep block anesthesia should be the method of choice, whereby the needle may be inserted and the solution deposited in normal tissue, never injecting into or through an infected area.

One of the most common of the superficial infections is acute Vincent's. In these cases, there is great danger of causing widespread and serious infection by the use of a local anesthetic, which should be avoided until the condition is brought under control by treatment. This is also true in the presence of any form of acute ulcerative gingivitis or severe infection about unerupted or impacted third molars.

There are general conditions which necessarily must be given careful consideration, but in which, by careful management of the case, block anesthesia can be used.

Patients suffering from cardiovascular disease, especially when accompanied by arteriosclerosis and hypertension, and those who have recently suffered from hemiplegia or apoplexy, have suspected exophthalmic goiter or hemophilia or are suffering from cardiac or other metastatic disease due to focal infection necessarily must all receive special attention.

In such cases, the patient should be properly instructed as to procedure and as to the sensations and symptoms that he is apt to experience. His confidence should be gained in order to prevent as far as possible excitement and fear as to the final outcome of the procedure.

Therefore, a careful study of all factors in the case will prevent many of the accidents occurring in and unfavorable sequelae of block anesthesia, and which, in many cases, could have been avoided had a proper diagnosis been made and decision as to procedure been reached before beginning operation.

ASEPSIS

Scrupulous asepsis must be adhered to throughout the entire procedure. Many operators give too little attention to the proper care and sterilization of syringes and needles, are careless with the preparation of the solution and give no particu-

lar thought to disinfecting the area of injection.

With the increasing popularity of prepared solutions sold to the profession in glass containers, which are manufactured to fit syringes of various designs, there has been a tendency to neglect careful preparation of the syringe and glass container before making the injection. When this form of prepared solution is used, the syringes should be boiled and, if prepared in advance, wrapped in sterile gauze. The glass container should be placed in a sterilizing solution for a sufficient length of time to assure an aseptic technic throughout.

All needles should be boiled and placed in sterile gauze in a sterile container, and should be removed for use with sterile forceps or pliers; or, as is practiced by many, they should be taken directly from the sterilizer with sterile instruments and placed upon the syringe at the time of their use. Although iridioplatinum needles, which may be flamed, are employed, sterilization by boiling is a safe procedure. A sterile needle should be used for each subsequent injection, the same needle never being used for additional deep block injections in various locations.

Particular thought must be given to the conditions surrounding the patient and to disinfecting the area of injection, every attempt being made to maintain a definite chain of asepsis and to prevent the introduction of infection.

PROPER ANESTHETIC SOLUTIONS

There are various local anesthetic agents which the dentist may use, some being prepared in tablets which, when dissolved in a definite amount of sterile distilled water or Ringer's solution, produce a proper anesthetic solution. Others are prepared as a stock solution, put up in ampul form, ready for use in accordance with the desires of the dentist.

Great care must be taken to have the solution absolutely sterile. Stock solutions should be injected only at body temperature. Too frequently, these solutions are taken from the package immediately before injection, no attempt being made to sterilize the glass container or to warm the solution to proper temperature.

Undoubtedly, the ideal local anesthetic at the present time is a freshly prepared procain solution, varying from 1 to 2 per cent, with the addition of a small amount of a vasoconstrictor such as epinephrin or the synthetic epinephrin. Many operators have found, by actual clinical experience, that a stock solution is more convenient and apparently as efficient as a freshly prepared solution. One should not consider the procain solution, as prepared by reputable pharmaceutic concerns of today, in the same way that many of the proprietary stock anesthetic solutions of a few years ago were considered.

If your experience with this type of anesthetic solution has proved successful, and it is your desire to continue its use, do so, but with the cognizance that these solutions should be secured as nearly fresh as possible, put up in clear glass containers and as nearly hermetically sealed as is possible. In its preparation for use, the solution should be warmed to near body temperature, and a sterile technic followed throughout.

Much effort is being put forth by research workers to perfect an alkaline anesthetic solution which will correspond more nearly to the tissue cells in alkalinity than do the present solutions of procain hydrochlorid. Such a solution, according to many authorities, will prevent much of the postinjection discomfort and many of the cases of syncope which

occasionally occur with the use of procain hydrochlorid.

Charles W. Freeman has conducted much of the recent research on procain borate in the investigations that are being made at Northwestern University dental department with alkaline anesthetic solutions.

ANATOMY

A thorough knowledge of the anatomy of the parts involved is essential to the successful use of block anesthesia. Many operators attempt to make deep block injections in a mechanical way, following a technical procedure the knowledge of which they have gained from lectures or from articles dealing entirely with technical phases. Each operator should be able to visualize the structures through which the needle must pass, the bony surface and the nervous tissue at the point of injection. When this knowledge is complete, block anesthesia ceases to be a mechanical procedure, becoming a definite surgical technic based entirely upon anatomic landmarks.

TECHNIC

An exact technic, based upon the knowledge of a simple, safe and efficient procedure, is essential to the successful use of block anesthesia. In the early use of local anesthesia, pressure was considered a necessary factor in any technic, and the all-metal syringe, with which the solution could be deposited in the tissues under great pressure, was an important part of the dentist's armamentarium.

It has been definitely established that anesthetic solutions should be deposited slowly, only sufficient pressure being employed to discharge them into the soft tissues along the mucobuccal fold or at the entrance or exit of the nerve trunk from its bony canal. This will prevent many of the unfavorable sequelae seen when the solution is deposited in the more dense surrounding tissues. Many operators rapidly inject a 2 per cent solution of procain-epinephrin with the patient in an upright position in the dental chair, with no regard to age or physical condition. This, especially in patients past middle life who are in a state of lowered vitality or are suffering from some cardiac or metastatic disease, results in a feeling of faintness, a rapid pulse, fullness of the chest and head and a distinct tremor; all of which can be avoided by the use of a weaker solution and slower injection, always with the patient in a horizontal or semihorizontal position, this being desirable in all injections regardless of the age or the condition.

Care must be taken to avoid depositing the solution directly in an artery or vein. This can be avoided by slightly retracting the needle after the proper location has been reached.

The apprehensive patient should be reassured and his confidence gained through the attitude and care of the operator and assistants. Some explanation should be made as to what the patient is to experience, such as the sting of the needle and the tingling and numbness of the part. Any further explanation required by the particular case should also be made. The attitude of the operator will do much to relieve the patient's apprehension, which causes many of the nervous symptoms that follow the injection of a local anesthetic and which are laid to the injected solution.

Some patients may experience a peculiar sensation over the entire body, especially in the extremities, following the injection of a local anesthetic. The face may blanch and break out in a cold, clammy perspiration, the pulse becoming rapid, the expression strained and worried; all of which symptoms are the re-

sult of a disturbance of the vasomotor centers, either from fear or from the effects of the injected solution. This is usually overcome by the administration of aromatic spirits of ammonia, either in a small amount of water or directly under the tongue by means of a medicine dropper, which proves very effective. Slapping the face with a cold, wet towel is an additional effective measure.

It is difficult to prepare a presentation on this subject without dealing extensively with technical procedures, which usually consumes considerable time, and which, investigation of dental literature reveals, has been presented many times and in much detail.

The injections of choice for the maxilla are: the posterior superior dental (tuberosity) for the upper second and third molars, with an additional deposit of solution along the mucobuccal fold over the first molar when this tooth is to be included in the procedure. If the operation is for removal of these teeth, it is necessary to block the anterior palatine nerve at the posterior palatine foramen. All other remaining upper teeth are blocked by depositing the solution along the mucobuccal fold above the teeth that are to be included in the operative procedure. If the upper anterior teeth from cuspid to cuspid are to be blocked for extraction, it is necessary to block the nasopalatine nerve at the nasopalatine foramen. The anterior superior dental (infra-orbital) injection is employed for anterior teeth with large cysts, impacted cuspids or teeth that require surgical interference of a more extensive nature.

The injections of choice for the mandible are: the inferior dental lingual injection, the long buccal injection usually being necessary for the removal of the lower second and third molar teeth, in conjunction with this injection.

The mental injection may be used in thin-boned persons and in younger people for the operation on the bicuspids and cuspid, the incisive injection being most desirable for the four lower anterior teeth. If operation is for the removal of teeth involving areas of the mental and incisive regions, it is also necessary to block the lingual nerve.

The successful use of block anesthesia involves the careful application of its fundamental principles in every case in which it is employed, and necessitates a definite decision as to operative procedure before beginning operation.

55 East Washington Street.

DISCUSSION

Arnott A. Moore, Buffalo, N. Y.: Dr. Miller has said that patients do not realize the importance of tooth extraction as a surgical operation. Many dentists do not realize it either. It has been said that there is no minor operation. When tissues are interfered with surgically to any extent, there is a definite chance of a serious result. Many dentists themselves do not realize the extent to which this is true. They should be brought to a full realization of the importance of any mouth operation, and should in turn educate the general public to the point where they realize it as well. If a patient is not willing to submit to a complete examination and proper operation, it is better to let that patient go where he will. The dentist, in performing seemingly simple operations, should be prepared for any of the surgical complications or accidents which may occur. His surgical training and armamentarium should be sufficient to meet any emergency. If this is not the case, he should under no circumstances undertake mouth operations. In a paper of this type, Dr. Miller could not go into a nitrous oxid-oxygen versus procain argument. Each anesthetic has its place. As explained by the glib salesman, it is very simple to give nitrous oxid-oxygen. We can, according to the salesman, give the patient certain mixtures so many minutes, and others so many minutes, and anesthetize the patient beautifully. Nitrous oxid-oxygen is in reality a very dangerous anesthetic excepting in the hands of an expert. In addition, it is impossible to give an anesthetic successfully and

perform an operation likewise at the same time. The general dentist cannot afford a full-time anesthestist, and, to my way of thinking, it is better to call in some one who has made a study of anesthetics than it is to give an anesthetic with unsatisfactory results. As is the case before performing any surgical operation, the general physical condition and temperament of the patient should be taken into consideration. For practical purposes, pure procain without epinephrin should be used in all heart, high-blood pressure, thyroid and kidney cases. Light complexioned people are sensitive to epinephrin. I believe that nerve blocking is very practical in cases of hemophilia because it gives the operator more time to complete his case. Dr. Miller has spoken of the danger of injecting in acute infection, both deep seated and surface. To my mind, we should never operate in the presence of acute infection. The condition should be treated until it has either localized or subsided, and then the operation performed. It is highly dangerous to operate, or inject, in cases of acute, or even subacute Vincent's. If we are careful never to operate in these cases, we will have comparatively little difficulty with nerve blocking. Too little attention is given to asepsis. One break in the chain is as bad as many breaks. Probably the weakest link found in general dental offices is the lack of sterile towels. Instruments are boiled and wiped on a so-called clean towel, fresh from the laundry, and are considered sterile. In all probability, they are not. Iridioplatinum needles which can be flamed are very satisfactory, but it must be remembered that the hub of the needle is not sterilized in that process. Boiling is the only safe means of sterilization. Formaldehyd solutions should not be used on syringes or needles unless the operator is sure that all of the drug is washed off before injection. A practical means of maintaining the sterility of a procain solution after it has been boiled is to put in a drop of pure phenol to the ounce. Each man has his own method of preparing procain solution, or he may prefer to buy it prepared. If he prefers to make his own, a solution of chemically pure potassium sulphate of the same density is suggested in preference to Ringer's solution. If ampuls are used, they can be kept in a 1:250 phenol solution. The ends can be broken off by inserting them in pieces of sterile cotton rolls. The operator should have a good practical knowledge of the structures that he is working on. This includes a definite knowledge of the position of the blood vessels, both large and small, and that of nerve positions. As Dr. Miller has said, the days of high pressure injection have gone. Slow deposition of procain solutions is very important for many reasons. In the first place, there is less local tissue injury. Secondly, there is less danger of injecting into blood vessels as it is easier to feel the release of resistance to the injection. If the needle is put in the place where it is intended to deposit the solution, and pressure of the plunger is released for a second or two, there will be a flow of blood into the syringe if the needle is inserted in an artery. Also, when the solution seems to go in too easily, the probabilities are that the needle is in a vein. In either case, the needle should be retracted slightly, the test made again and, if satisfactory, the injection made. The sensations subsequent to injection should be explained to the patient. If the patient is of a nervous type, it is well not to make too much ado over the matter of injection. In such cases, it is well to send the assistant out of the operating room while the injection is being made. In case the patient has a marked reaction to the injection, he should be placed in a prone position and any of the remedies that Dr. Miller has suggested be applied or a one one-hundredth grain tablet of nitroglycerin may be placed under the tongue and the patient reassured. The operator should indicate on the patient's card that he is sensitive to epinephrin and the next time he is given an injection, a pure 2 per cent procain solution, without either of the above-mentioned drugs, should be used. As regards palatal anesthesia, it does not seem necessary to me to block the anterior palatine foramen to extract upper molars. It is my practice to avoid the foramina as much as possible. In the case of a mandibular injection, it seems to me just as well to block along the mucobuccal fold rather than to make the long buccal injection. In the extraction of the lower anterior teeth, the injection for the genial tubercles is often of great assistance.

Charles W. Freeman, Chicago, Ill.: Dr. Miller's statement that no one anesthetic is suited to all cases or for all operations is without question correct, but I feel that a local anesthetic meets the requirements in such a large proportion of the cases in a dental office that it should supersede general anesthesia.

Unless the dentist is a specialist who can surround himself with trained assistants, the use of a general anesthetic in the dental office is seldom satisfactory and is professionally and economically inexpedient. There is a growing tendency to hospitalize all patients requiring a general anesthetic, and it is certainly a most satisfactory procedure for the operator, although it may not be entirely practical economically from the viewpoint of the patient. Dr. Miller's advice regarding the control of acute infections before the removal of the teeth is entirely in line with my views, and while there is yet some controversy on this subject, my own observations have entirely justified the conservative management of acute infections, avoiding all operative procedure except incision for draining until such time as the infection is definitely under control by the protective mechanism of the tissues. Operations performed in the presence of Vincent's infection are undoubtedly likely to lead to dangerous conditions and should be postponed until safety is assured. We are constantly operating in the presence of acute infections, and as a profession we have not yet learned the serious consequences which may attend trauma of mouth tissues in the presence of infections which are not completely under control. The subject of local anesthetic agents has been too long neglected by the dental profession, and we find an unfortunate situation in that practicing dentists are applying to manufacturers and salesmen for information regarding the materials to be employed. The manufacturers have in many cases been responsible for distinct advances in the preparation of pharmacologic products and in the methods of dispensing them, but it is basically the duty of the profession to pass judgment on the quality and value of the products submitted. Until recently, there has been no agency in the dental profession capable of furnishing to the profession authoritative information regarding proprietary preparations. The Council on Dental Therapeutics has an opportunity to be of inestimable value to the profession if the profession will cooperate and support the Council. In the selection of local anesthetic materials, the practicing dentist has been interested in adopting a plan which would be simple, easy and time saving, and the result has been a general acceptance of the ampul and the carpul, notwithstanding the fact that practically every authority in this field has stated that a freshly prepared solution is preferable. There is no question of the integrity of the reputable manufacturers of stock solution, nor is there any doubt that they make every effort to prepare their product in the most careful and scientific manner. The fact remains that the stock solution containing procain and epinephrin is subject to deterioration, and when such solutions have been kept for some time or exposed to heat or light, the integrity of the solutions is often in doubt. I have always favored and used a freshly prepared solution, and recent investigations carried on by the departments of chemistry, pharmacology and oral surgery at the Northwestern University Dental School have offered further convincing evidence in favor of the fresh solution. In addition, we have devised a method of preparation for use in the dental office whereby a fresh solution may be prepared with as little sacrifice of time as with the use of stock solution. The most important requirements of the local anesthetic solution are: (1) that the solution shall be sterile; (2) that it be capable of producing perfect anesthesia without toxicity when properly injected; (3) that it be reasonably rapid in action, and (4) that it shall not cause local tissue irritation. We may safely say that a freshly prepared solution of procain hydrochlorid does not entirely meet all these requirements and that many of the stock solutions are entirely inadequate. The two requirements which are better fulfilled with the materials which we have investigated are (1) more rapid induction of anesthesia and (2) less local tissue injury. The loss of time in the dental office made necessary by waiting after injection for effective anesthesia is too important to be overlooked. The dentist who employs a local anesthetic cannot afford to wait ten or fifteen minutes for anesthesia, if materials are available which will give the same result in much less time. In the voluminous book on this subject, Arthur E. Smith states: "In the average case ten or twenty minutes should elapse for perfect anesthesia following the inferior dento-lingual injection, the average time being fifteen minutes. The author has been able to extract teeth or perform other oral operations in seven minutes following injection." Such a delay in the induction time of anesthesia appears from our experiments to be entirely unnecessary, and in several series of such injections that have been reported, the

longest induction time was considerably less than seven minutes and the shortest about one minute. These facts have been proved by more than 25,000 injections in the clinic and by constant use by me and by several of my colleagues in private practice for two years. The investigations which have been carried on with local anesthetic solutions indicate rather conclusively that the p_H value of the solution is the determining factor in the efficiency of the anesthetic; and while much work remains to be done in this field, clinical evidence has established the practical value of solutions with a high p_H value. Procain borate, which has a p_H of 8.4, is effective in anesthetizing gold fish in about one-tenth of the time necessary with ordinary procain in the same concentration. Procain hydrochlorid may be buffered by the addition of a suitable alkali, the p_H being raised thereby to any desired point and the anesthetic efficiency being apparently determined by the p_H to which the solution is raised. Procain hydrochlorid solution with epinephrin has a p_H of about 5.3, which is decidedly acid, since a p_H of 7 indicates neutrality, and all stock solutions which have been tested are very acid with a hydrogen-ion concentration which may range as low as p_H 3.3. Such acid solutions are much more stable and therefore more satisfactory from a commercial point of view, but when we consider that the p_H of normal blood is 7.4 and is never reduced below 7, we may well question the desirability of introducing such an acid solution by hypodermic injection. Clinical evidence amply supports the fact that an alkaline solution with a p_H of 7 or more is not only more efficient in producing anesthesia but is also much less irritating to the tissue and causes less immediate systemic reaction. Theoretically, I believe that the p_H of the anesthetic solution should be as nearly as is practical that of the blood, but clinical experience suggests that an alkaline solution is preferable to an acid one. The limits of efficiency appear to be reached when the p_H is about 8.4, as above that point dissociation of the drug is very rapid. We are not ready to state which alkaline material is preferable for buffering procain solutions. Our principal work has been carried out with procain borate, which is alkaline, having a p_H of 8.4, and therefore needs no added buffer, and with procain hydrochlorid buffered by the addition of potassium carbonate or sodium carbonate. We have used these buffered solutions with a p_H ranging from 7 to 8.4, and practical observation shows greater efficiency with a higher p_H value, but extremely satisfactory results are obtained with any solution buffered to or above the p_H of the blood. We tentatively explain the increased efficiency of buffered solutions in this way. The active material which produces anesthesia is the free procain base. Until this base is dissociated from its salt, no anesthetic action occurs, and this dissociation takes place much more rapidly in an alkaline medium. This is noticeable in the rapid deterioration of alkaline procain solutions, making them too unstable for manufacture as stock preparations. The reduced amount of local tissue irritation can easily be explained on the basis of a minimum variation between the p_H of tissue and that of solution. The acid solutions must be neutralized immediately on introduction, and this is accomplished at the expense of tissue cell injury, resulting occasionally in postoperative pain and delayed healing. The lesser number of general systemic reactions with solutions of high p_H is less easy to explain, but is a definite clinical fact. There is a tremendous amount of work yet to be done in this field, and many of our findings require further verification, but the results to date have been so encouraging that we feel the endeavor has been amply justified. Since the use of a local anesthetic is such an important part of the everyday routine of practically every dentist, and the possibilities for good or harm are so continuously present, it is clearly our duty to make every effort to extend our present knowledge and perfect our methods of administration. If, as we believe, the freshly prepared solution is to be preferred to stock solution, we should be willing to organize our routine of preparation to permit its use. As a matter of fact, a routine procedure can be easily established, and one has been established in my office, whereby any acceptable method of preparation is assured with no more delay to the operator than in the use of stock solutions. We believe that the adoption of the all-glass Luer syringe is advisable to assure absolute sterility, and this syringe has been the only one employed by us for more than two years. It is sterilized and wrapped in sterile gauze and kept ready for use. The time has come when we must make definite advances in local anesthesia. We have too long been willing to accept the conclusions of our predecessors and have been will-

ing to accept a fairly good local anesthetic solution without sufficient attempt to make improvements in this field comparable to those in other phases of dental practice.

CLINICAL RESEARCH BY THE GENERAL PRACTITIONER: A NEW CONCEPT OF DENTAL RESEARCH WITH A PLAN FOR ITS ACHIEVEMENT*

By JAMES L. ZEMSKY, D.D.S., New York City

. . . . every one of us, even if he be only a simple country doctor, will make his own useful contribution.—Claude Bernard.

THE accompanying illustrations show several conditions which are familiar to every practitioner. Here, we see unerupted, impacted and malposed teeth (Figs. 1-3), embedded roots (Figs. 4-6), hypercementosed teeth (Figs. 7-8), areas of sclerotic bone situated in both the maxilla and the mandible (Figs. 9-10) and broken needles (Figs. 11-12).

The question which arises in connection with these conditions is, "Should these unerupted teeth, buried roots, hypercementosed teeth, areas of sclerotic bone or broken needles be removed?"

The answer to this question will vary from an emphatic affirmative to a negative just as emphatic, with all the intervening shades of opinion, or even the absence of any conviction. Obviously, all are not correct. Equally obvious is the fact that it is vitally important to know which are wrong and which right, for the intervention of surgery with all its entailments depends on such differentiation. Any improper use of surgical measures is not infrequently followed by serious sacrifices, such as loss of teeth or of useful appliances or the necessity of discarding good restorations and replacement of them by others less satisfactory, not to mention the financial loss that such operations necessarily incur.

Eight years ago, I read a paper before the Scientific Section on Oral Surgery of the First District Dental Society of the State of New York entitled, "The Status of Unerupted, Impacted and Malposed Teeth,"[1] pointing out that the situation was chaotic and expressing the hope that the members of that section would manifest a greater interest in the subject and in its further investigation. About two months later, the paper was published and later it was reprinted, the subject being thus given sufficient publicity to attract the attention of the many specialists. What were the results? None. The same communication could be just as effectively presented and published today and it would prove just as timely. In other words, since its delivery and publication, no progress has been made in this field. The situation today is absolutely the same as it was eight years ago, and there is no indication that it will be different eight years hence, unless the attitude

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*Read before the Section on Histology, Physiology, Pathology, Bacteriology and Chemistry (Research) at the Seventy-Third Annual Session of the American Dental Association, Memphis, Tenn., Oct. 20, 1931.

1. Zemsky, J. L.: Orthodontia, 9:537 (July) 1923.

2. Zemsky, J. L.: Dent. Facts, 2:31 (Oct.) 1923.

toward the general practitioner changes and he is regarded as an investigator and assigned the rightfully important place in the scheme of research which no one but the general practitioner can fill.

The prevailing opinion among scientific investigators is that a general practitioner cannot do research work, which may be true under the present circumstances, but does not mean that the situation cannot be changed. Much effort may be required to produce such a change, but it is possible to do so, and prompt recognition of this fact will do much to effectuate a remedy.

Let us go back to the illustrations presented, i.e., unerupted, impacted and malposed teeth, embedded roots, hypercementosed teeth, sclerotic bone and broken needles. No amount of laboratory research can settle the mooted question: Do these cases require operation? No amount of clinical observation by the specialist will answer this question satisfactorily. Further elaboration of this point is necessary. Let us first consider the value of laboratory research in this connection. Impacted teeth may be studied from the histologic, pathologic and bacteriologic points of view. It will be observed that, in a certain percentage of these teeth, there exists a disturbance of the pulp and the presence of hypercementosis. The presence of pathogenic bacteria has likewise been demonstrated in a certain percentage of them. But the question remains: What is the clinical significance of all this? The reply is that no matter how many laboratory investigators are engaged in the study of unerupted and malposed teeth, the clinical significance of these teeth could not be determined in this way: the answer must come from the general practitioner, and for these reasons: For many years after operation, he sees the patient and therefore is able to judge effects much better than is the specialist who sees the patient only for a short time. Undoubtedly, every oral surgeon has seen patients whose unerupted teeth have been removed and who are miraculously "cured" as far as he knows; but did they all remain cured? The general practitioner who has treated those "cured" patients several years has subsequently probably made a different observation. The reverse may also be true. There are cases in which no seeming improvement occurred directly after the operation, but in which there may be a great deal of improvement months or years later.

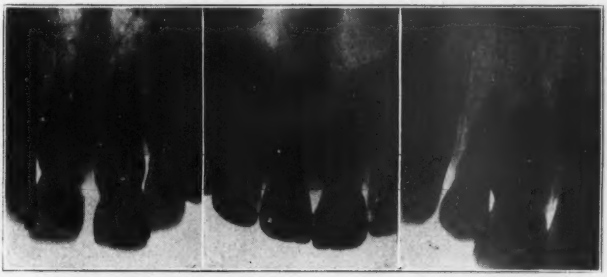

Fig. 1.—Unerupted, malposed supernumerary maxillary teeth.

These data can be gathered neither by the laboratory worker nor by the specialist. On the other hand, it is a very simple task for the general practitioner.

From the histologic point of view, embedded roots that show no roentgenographic signs of any pathologic condition should not cause any disturbance to the patient, for they represent normal cementum covering the fractured portion, which is sufficient evidence that the surrounding tissue is tolerant to it. (Fig. 13.) Why, then, must a mouth or jaw be mutilated even to a very small degree and restorations be destroyed and new appliances constructed? Is there any justification for subjecting the patient to such procedure? A general practitioner who has observed the patient for many years subsequent to the operation may be able to answer definitely all these exceedingly important questions.

As to hypercementosis, from the point of view of histologic study, there is nothing in this condition (barring the presence of other pathologic processes) that would indicate the necessity of removal, and yet many such teeth are sacrificed, with all the sequelae of such operations. The general practitioner, having observed such patients for many years, would be in a position to determine the value of the operative procedure were he to set out to do so.

Whatever has been said concerning the benefits resulting from or sacrifices necessitated by the surgical removal of unerupted and malposed teeth, embedded roots and hypercementosed teeth of the types shown in the illustrations presented is also true of cases of osteosclerosis.

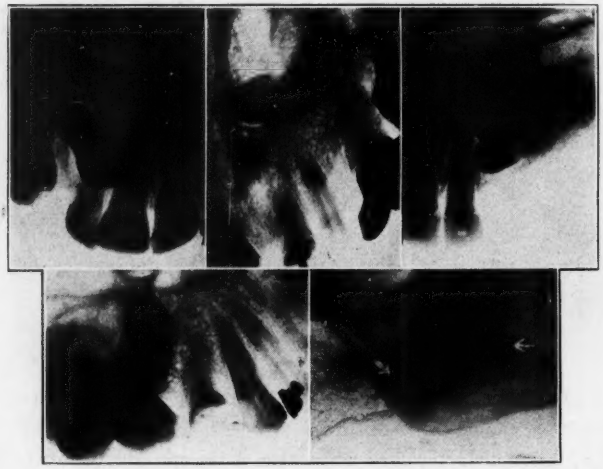

Fig. 2.—Unerupted, malposed maxillary teeth.

Laboratory investigation may demonstrate that there is a variance in the histologic structure of sclerotic bone in different cases. In one, there may be an unusually dense cortical bone, but the spongy part of the osseous structure presents no deviation from any other spongy bone; while, in other cases, the reverse is observed, i.e., the cortical bone is quite

normal, but the spongy portion is unusually dense. Histologic study may reveal further that, in some cases, density of bone is due to the presence of an increased number of bony trabeculae; while, in others, it is due to the type of trabeculae, i.e., their thickness. (Fig. 14.) Extensive study will probably disclose many other equally interesting facts; but until and unless there is a mass of evidence that the elimination of this roentgenographically observed structure definitely benefits the patient, there would seem to be no justification for the employment of radical therapeutic measures.

Finally, broken needles should be mentioned. Those persons who have been subjected to operation for their removal, as well as those employing the procedure, will readily agree that it is devoid of pleasure. Needles are broken despite the utmost care, and it is exceedingly difficult to prevent such accidents. The question still confronting us is, "Does such a condition call for operation? As we all know, some surgeons maintain that the operation is unjustifiable, while others insist on its performance. Who is right? Obviously, only the general practitioner is in a position to observe the behavior of such patients, study them and say the last word.

The illustrations presented are but a few that I have observed in daily practice. That there are numerous other conditions presenting perplexing problems to practitioners whose interest and professional activity lie in other fields, there is no doubt. Probably, a familiar example of such a condition concerns the theory of oral foci of infection. At no time has the truth of this theory been more widely questioned and advocated. It seems that any one who has been observing the attitude of the general practitioner would be led to believe that more and more dental surgeons are joining the ranks of the conservative group. As far as the physician is concerned, one can say almost unhesitatingly that the same thing is true. Waldron,[3] for instance, points out that "when one discusses the relationship of diseases of the mouth and systemic disease with experienced pathologists, one is immediately beset with the thought, Is there any important relationship?" He further calls attention to the fact that " . . . a survey of the textbooks on pathology shows that the authorities on this subject, which is so fundamental to the science and art of medicine, have been very slow to accept the presence of dental focal infection." He goes on to illustrate this

Fig. 3.—Unerupted, malposed mandibular teeth.

3. Waldron, C. W.: Basic Medical Courses, Dent. Survey, 7:63 (May) 1931.

statement by saying that " . . . recent textbooks in pathology give this subject but little space." In a recent textbook,[4] about sixty lines are devoted to the general discussion of focal infection of teeth, tonsils, sinuses, gallbladder, appendix, etc. Reference to the teeth as foci includes about six lines:

> The importance of the teeth as sites of focal infection has been overemphasized by many physicians. Latent dental infections, root granulomas are seldom responsible for metastatic lesions. Hypertension is not due to focal infection and the practice of extracting suspected teeth in this condition is to be condemned. Obscure anemias are usually not caused by focal infection.

This situation is substantiated by Pollia,[5] who says:

> The topic of focal infection concerns the dentist much more than the physician. For the physician it is, or should be, but one of the influences which affect health, whereas for the dentist, because of the limitations of his work and the ease with which teeth are injured by disease and therapeutic measures, it becomes at once the perspective by which the theory and practice of dentistry are now being judged.

All of this points to one thing: The question of focal infection is still unsettled and the medical profession will not settle it, leaving this burden to the dentist. Dentistry, on the other hand, has produced excellent research workers in the field of animal experimentation in connection with the study of this problem. Its fascinating laboratory study has failed to settle the validity of the theory of focal infection and the clinic thus far has failed to clarify the confusion despite the fact that some very capable investigators and observers have participated in the study of this subject. The cause of the failure is quite apparent. The general practitioner has not been included. In other words, the method of approach is wrong; and, consequently, if any satisfactory results are to be achieved, the line of attack must be changed.

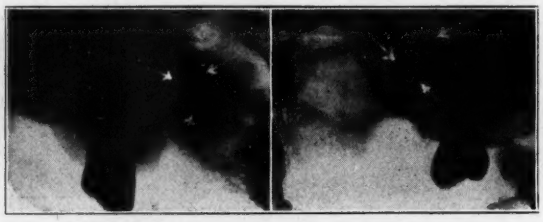

Fig. 4.—Roots forced into antrum.

IMPORTANCE OF THE GENERAL PRACTITIONER IN SCIENTIFIC INVESTIGATION

So much, then, for the place of the general practitioner in any investigation to determine the necessity or value of different operative procedures as therapeutic measures in coping with the various conditions herein prescribed. Valuable as this may be, the participation of the general practitioner in research cannot be limited to what may be called the practical phase of investigation only. His contribution to the purely scientific aspect may prove invaluable; for the observation of the general practitioner, because of his peculiarly advantageous

4. Bell, E. T.: Pathology, Philadelphia; Lea and Febiger, 1930.

5. Pollia, J. A.: Newer Concept of Focal Infection, J. Dent. Res., 11:83 (Feb.) 1931.

situation, as compared with that of the laboratory worker and the specialist, may prove of singular importance. He is in a position to study the patient for a long period of time, a thing impossible either for a laboratory worker or for a specialist. He can observe the changes which may occur in a patient from the early days of childhood to adolescence, and, in some instances, even to old age. He comes in contact with many members of the same or related families so that he has an opportunity to study his patients from the point of view of hereditary and familial influences, environment and other angles. To illustrate, a few concrete examples may be presented.

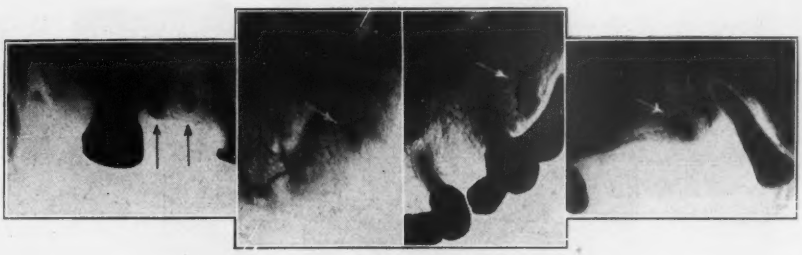

Fig. 5.—Embedded roots in maxillae.

In our investigation of hypercementosis, it was observed that there appeared to be an hereditary etiologic factor. Several cases of hypercementosis which came to our attention suggested that such a relationship is not only possible but also actually exists. Nevertheless, it would be neither logical nor scientific to draw a definite conclusion based upon these scattered cases so slightly observed. For that purpose, a great quantity of such material would have to be thoroughly studied, possibly thousands of patients, but for us this proved an insurmountable difficulty. How could so many patients presenting such a condition become available for study? Our source of this material was rather limited, and it would take many years until either we or others similarly interested in the study of this problem would be able to gather a sufficient number of such cases to draw any definite conclusions. On the other hand, if the general practitioner were engaged in such research, he could, with greater facility, select the patients for observation; and if a large number of such practitioners were working on the same problem, sufficient material could probably be gathered in a comparatively short time. With a set of definite rules to follow, any general practitioner may become an efficient worker in this particular investigation. This plan of procedure is described in detail in a communication recently published.[6]

Another instance in which the general practitioner may render actual scientific assistance in connection with hypercementosis concerns determining whether the condition is or is not an arthritic disturbance. As I stated in a paper presented last spring before the New York Section of the International Society for Dental Research, it is no task to ascertain the relationship between hypercementosis

6. Zemsky, J. L.: Heredity and Hypercementosis, Dent. Items Int., 53:331-347 (May) 1931.

and arthritis, and the general practitioner may carry on the investigation quite efficiently, since it merely necessitates roentgenographic examination of the hands of those presenting hypercementosed teeth.[7] The plan of investigation is fully set forth in the communication just mentioned, which will appear in the *Journal of Dental Research.*

A further problem to be solved in the near future, thus preventing unnecessary sacrifice of teeth, is whether hypercementosis gives rise to reflected and diffuse pain and discomfort and is, as claimed by numerous writers, the cause of various pathologic conditions such as neuralgia, functional blindness, functional deafness, chorea, epilepsy, paralysis, cardiac neuralgia and insanity.

Is it possible for isolated laboratory workers or a few clinical observers, regardless of their ability in research work, to determine the validity of this theory unless they observe a great many such cases? Obviously not, and it is equally obvious that they are not in a position to examine the required number of patients with such disturbances. Such a vast problem could be definitely solved only if a large number of general practitioners were engaged in its study. For them, it would be a simple task, the only requisite being examination of the teeth of patients suffering from any of the manifested disturbances to demonstrate either the presence or absence of hypercementosis, thus establishing the rôle of hypercementosis as an etiologic factor in these cases. Conceivably, such an investigation might also determine another phase of the problem, i.e., prove or disprove that the removal of hypercementosed teeth cures these conditions. In order to accomplish this, it would be necessary for the practitioner to observe the patients after the removal of the hypercementosed teeth. Naturally, it should be understood that

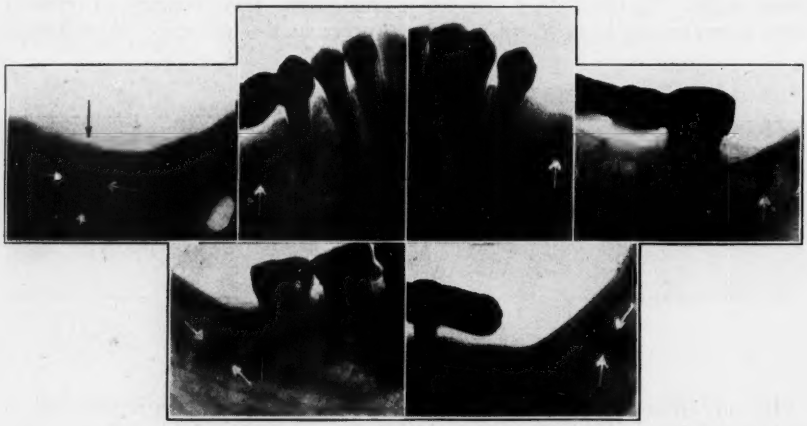

Fig. 6.—Embedded root apices situated in mandible.

7. Zemsky, J. L.: Relationship of Hypercementosis to Arthritic Disturbances, Dent. Items Int., 53:739 (Oct. 1931.

all other pathologic conditions ought to be eliminated prior to extraction of hypercementosed teeth.

SKEPTICISM OF RESEARCH WORKER REGARDING INVESTIGATION BY GENERAL PRACTITIONER

It has been previously stated that the attitude of the scientific investigator toward the general practitioner as a research worker is that of a skeptic. I wish to present at this time some facts partially justifying such an attitude.

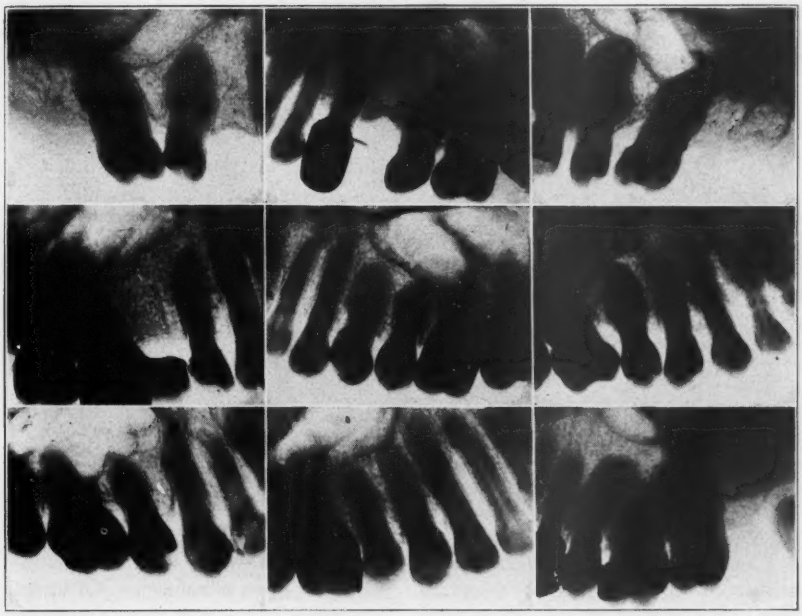

Fig. 7.—Maxillary hypercementosed teeth.

As already mentioned, during the last two years at Professor Bödecker's oral histology and embryology laboratory at Columbia University dental school, an investigation of hypercementosis has been conducted. In connection with this research, a questionnaire has been sent to a number of practitioners, most of whom are engaged in the practice of some specialty. It was expected by this means to gather certain clinical data bearing directly on the subject under investigation. This the study has failed to do, but it has led to some interesting and important observations. The replies revealed the following:

1. Some practitioners are not at all interested in any dental scientific investigations; these do not offer any information. This deduction is based on the fact that only about 60 per cent of those to whom the questionnaire was forwarded sent replies.

2. Some practitioners are ready to make statements based on guesswork. For

example, when asked whether the condition of the patient had improved after operation, they replied, "Usually" or "In many cases" or "Yes, until other teeth became involved." Information obtained from those to whom research is not serious is of no value in research work.

3. There are those who are apparently not making any study or observation, but who nevertheless aim to convey the impression that they are doing scientific work. They mention having observed conditions which are definitely known not to be possible. For example, "The majority of hypercementosed teeth are vital." Information furnished by such practitioners is absolutely unreliable.

4. Many practitioners not prepared or equipped to carry on research work would not admit the fact and gave evasive answers. The information of such observers is useless.

5. Certain practitioners, although supplying information, are not in a position to make any deduction or correlation. This information is nevertheless valuable, in that it throws some light on the problem which is under investigation.

6. Some practitioners offer facts which, although not bearing directly on the subject under consideration, have some relation to it. Such information may be utilized in some other study.

7. A great many practitioners who have not been making any observations and who offer no information express their desire to do anything that may be of assistance in such a study.

With the exception of those classified under paragraph 1, no attempt has been made to estimate the percentage, for it is not of any great consequence. Of utmost importance is the fact that information obtained from all these practitioners is valueless, and consequently useless for purposes of scientific investigation—a contention of most research workers which partially justifies the attitude that they assume.

Those who have followed the presentation to this point will appreciate the words "partially justifies the attitude" of the research worker. The few examples mentioned indicate that no amount of

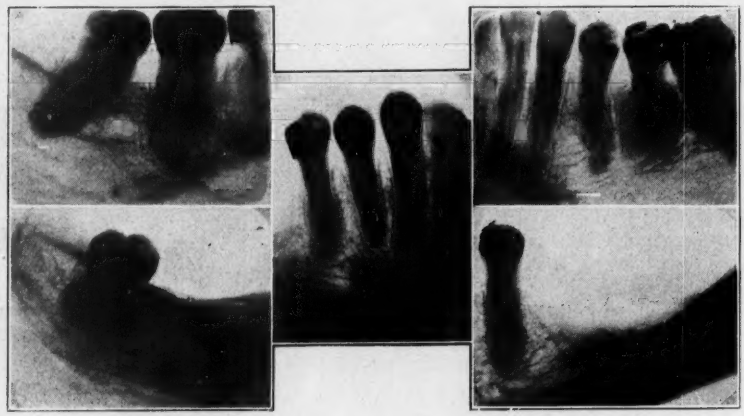

Fig. 8.—Mandibular hypercementosed teeth.

laboratory investigation or clinical observation by a few specialists could possibly solve their problem. Attention has been directed to the importance of these problems and it has been pointed out that these are but a few which have come to my notice and that certainly a great many more exist. Furthermore, it has been shown that the general practitioner is a necessary factor in any scientific investigation whether it aims at a practical solution of some definite problem or seeks to interpret or explain some existing conditions. Finally, it has been suggested that the general practitioner does not offer any help in solving these problems. All of this proves the contention of the research worker, i.e., that the general practitioner is useless in the scheme of scientific investigation. And yet, I maintain that the research worker is only partially justified in his attitude. Why? Because it is largely a matter of educating and training the general practitioner to become alive to these problems and the situation can be readily modified in the near future. That this idea is not original is apparent. In a study of the literature on the subject, in this connection, Pollia[8] states that "a well trained clinician is just as capable of carrying on a research problem as a full-time student, provided he or she confines the investigation to clinical problems." And that this view is not new is evident from a study of much older works, among which that of Claude Bernard stands out prominently. This brilliant investigator says[9]:

> I try to show them that they are called to contribute their share to the increase and development of experimental or scientific medicine. For that reason I ask them to familiarize themselves with the modern methods of investigation put in use in anatomical, physiological, pathological and therapeutic science, because these various branches of medicine must always remain inseparably united in theory and in practice. I tell those whose path leads them toward theory or toward pure science never to lose sight of the medical problem, which is to preserve health and cure disease. I tell those whose career,

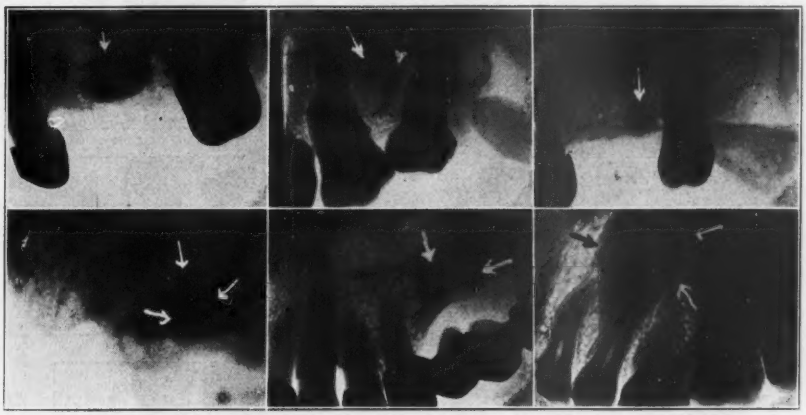

Fig. 9.—Areas of sclerotic bone in maxilla.

8. Footnote 5, p. 85.

9. Bernard, Claude: Introduction to Study of Experimental Medicine, New York, The Macmillan Company, 1927.

on the contrary, guides them toward practice, never to forget that if theory is meant to enlighten practice, practice in turn should be of use to science. Physicians thoroughly imbued with these ideas will always keep their interest in the progress of science, at the same time that they do their duty as practitioners. In noting accurately and acutely the interesting cases that present themselves, they will understand how fully science may profit by them. Experimental scientific medicine will thus become the achievement of us all; and every one of us, even if he be only a simple country doctor will make his own useful contribution.

If, in the foregoing quotation, the word "dentistry" should be inserted wherever "medicine" is mentioned, it would apply equally well in our own profession and, to this end, a definite plan of procedure is herein presented, which, when followed, will so alter the present mode of investigation within a short time that a large army of investigators will be created through whom many perplexing problems can be readily solved.

TRAINING THE GENERAL PRACTITIONER FOR CLINICAL RESEARCH WORK

It is singularly fortunate that, in this particular field, many years of preparation are unnecessary, and an efficient clinical research worker may be produced without the years of training and experience usually required to become proficient in other branches of scientific investigation. The only requisites for participation of

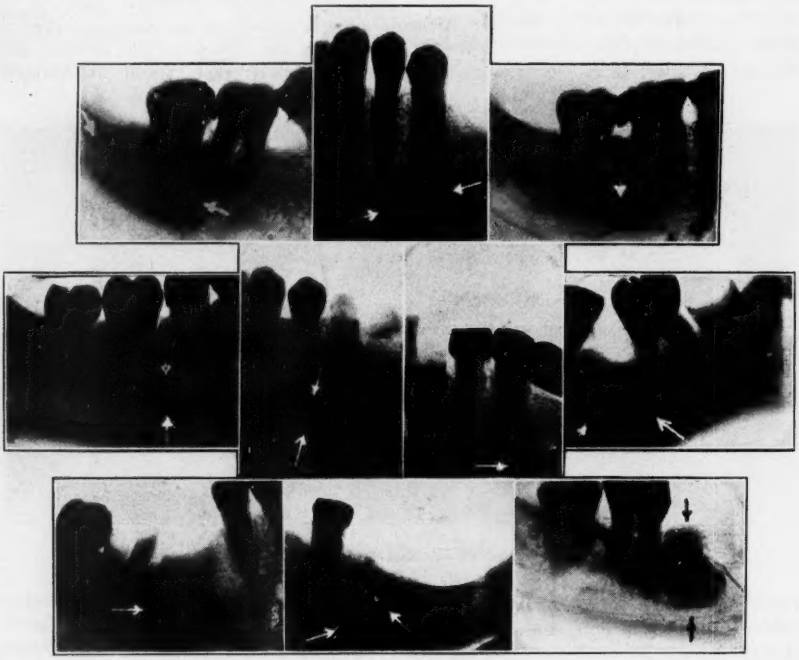

Fig. 10.—Areas of sclerotic bone situated in mandible.

the general practitioner in scientific research are acquaintance with the principles of such work, and realization of its importance.

These fundamentals should be taught in the dental school as part of the curriculum. The dental student should be acquainted with the fact that there are many unsettled problems in the practice of the profession for which he is being trained, and that these problems could not be solved without the general practioner, who must therefore take an active part in it. It should be pointed out that the first patient whom the student may see on his entrance into practice is the very patient needed to complete some extensive study and that therefore he must not be passed unnoticed. The attention of the future practitoner should be directed to the fact that this clinical research, important as it is, will not require any great sacrifice of time or energy and that all that it demands of him is accurate observation and careful recording of findings. He should also be impressed with the fact that although it is a question of "mass of evidence," no one practitioner will have to be on the lookout for very many cases, and that it is only necessary to collect a dozen or more cases, which, when multiplied by the thousands of practitioners engaged in the work, will furnish the required "mass of evidence."

It would be well to include in the curriculum the subject of clinical research, to be taught in the senior year, devoting to it some half-dozen lectures. This will be no burden whatever to the student for it will require no preparation. Besides, its direct effect in preparing him for research work will prove most beneficial. From the very beginning, it will instil in him a sense of seriousness toward the significance of his future work, a factor of great importance. The lecture should include discussion of such topics as: (1) importance of research; (2) value of clinical research in this connection; (3) keeping records of cases under investigation; (4) association of the graduate with some research organization; (5) relationship between the practitioner and the research laboratory of his school, where he can get assistance in the form of specific direction and other aid; (6) outlines for preparing reports for publication and presentation.

In a word, before the student leaves

Fig. 11.—Broken needle in mandible.

Fig. 12.—Broken needle in maxilla.

college, he should know at least this regarding the value and methods of clinical research and his rôle in furthering it.

This topic, introduced for discussion at the annual meeting of the Association of Dental Schools, may lead to the adaption of some uniform plan of action, and, if so, in one year would result in the development of several hundred well-prepared young enthusiastic clinical research workers whose influence on the scientific future of dentistry would be far-reaching.

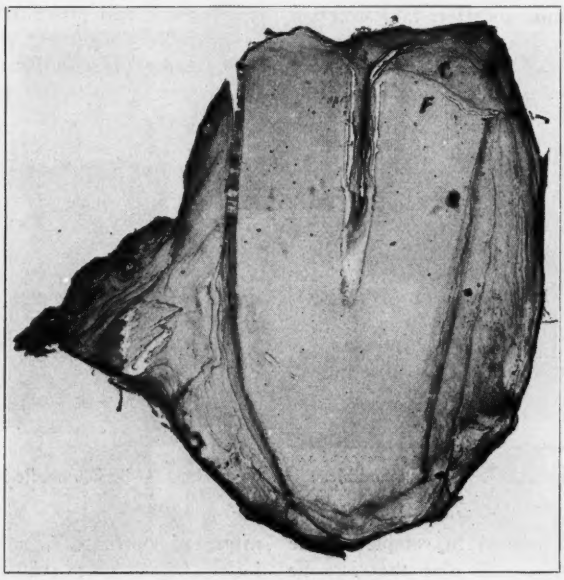

Fig. 13.—Low power photomicrograph of apex retained in mandible in region of molars. *F*, fracture of root. *C*, cementum completely grown over it.

CLINICAL RESEARCH DURING THE TRANSITION PERIOD

Meanwhile, clinical research must be conducted. This may be done with the aid of those general practitioners who are willing to do and capable of doing the work. As mentioned, there are some general practitioners—those classified under paragraphs 6 and 7—interested in research work and offering themselves for this purpose. Such practitioners will require a little training, which may be given in the form of a definite set of rules to be followed.[6] For purposes of study, several sections may be formed in connection with the district societies, similar to pathodontia and preventive dentistry sections, to each of which some particular problem is assigned. Those workers who desire to study one problem might be classed together. There might even be several sections devoted to the study of the same problem, in order that the re-

sults of one section could be verified by another.

All the clinical research workers might be divided into two groups. One of these would require that the entire work of the individual observer be carried by him to completion; the other would permit the practitioner to accumulate all the data and then hand them over to a body consisting of those properly qualified for its final analysis, correlation, summary and conclusion. Such a body, constituting a clinical research center, might render aid to individual members.

Fig. 14.—Low power photomicrograph of area of sclerotic bone in maxilla.

The accumulation of data on one particular subject will prove an easy task if the practitioner will keep separately all his records of the patients presenting the particular condition under investigation, thus facilitating ready reference. This might be further simplified by the use of record charts of different size from that used for routine examination. Such special records are quickly located. At some set period, say every three or six months, an invitation should be sent to these special patients to come to the office if they do not return voluntarily. Careful notations should then be made regarding any change which has occurred in their condition. When other observations are made, they should be recorded. At the same time, various tests or roentgenograms might be made, should this be found necessary.

The specialist may aid the general practitioner in such investigation by notifying him of the discharge of the patient under his care and his return to the regular dentist either for other work or for observation. Thus, the patient will not be "lost," as is frequently the case.

CLINICAL RESEARCH SOCIETY

It is a fairly well recognized fact that one does not care to work unless there is some impelling force. In this connection, an organization devoted to the fostering of clinical research would prove helpful. But in order to be effective, it should be founded upon the principles underlying the observation mentioned. The organization should offer an incentive. The

best incentive for a person who would be of the type apt to accomplish anything of value is recognition of his efforts. To that end, different kinds of memberships and fellowships should be provided. It should be so arranged that these various types of memberships be within reach of those who aspire to them, and for that reason there should be rules regulating their bestowal. Definite requirements should be outlined for the applicants, and, when these are fulfilled, the candidate should receive his reward. There should be no restriction; on the contrary, it would be better that every practitioner be a fellow of this organization. For instance, it should not be essential for a member applying for recognition to present some original work, because not every one is capable of doing that, and yet almost any earnest and serious minded practitioner is able to do some kind of clinical investigation and, therefore, would prove to be an efficient clinical research worker. By repeating the work of some other investigator, such a worker will either corroborate the findings, thus leading to their final acceptance, or prove the observation inaccurate, thus disapproving the theory and thereby leading to its rejection. It is for this reason that a worker who may not be of the type and caliber acceptable to other research societies will be most welcome in this organization, the policy of which should be that of encouraging the general practitioner.

In order that this type of organization may be effective in its work, it should be large—something similar to the American Dental Association or an integral part of it. In this way, it would carry great moral support and have the necessary financial backing. It should be possible also to maintain a research laboratory with a staff of well-trained workers, technicians and statisticians, who would be ready to assist those members seeking aid in their investigations.

A journal with an able editor likewise might prove of great value in assisting in the publication of the report of those members whose work may not be acceptable to the leading periodicals. It is essential, of course, that such an organization be well represented throughout the entire profession.

Such an organization might have various other functions, one of which would be to bring about the proposed plan of including in the curriculum of dental schools the subject of clinical research, a logical and effective solution of the problem of clinical research.

CONCLUSION

I do not claim to be the first to propose the participation of the general practitioner in scientific research. That was recommended long ago by Claude Bernard, and various attempts have been made in this direction. The point that I am making here is that every general practitioner should participate in research, particularly directing his attention to the clinical aspect of it. Through such a plan, first, a mass of evidence would become available and, secondly, the great number of cases will offset individual variations or errors, thus making the results obtained not merely convincing but also conclusive.

To quote from Claude Bernard's book, written in the middle of the nineteenth century[9]:

> I tell those whose career . . . guides them toward practice, never to forget that if theory is meant to enlighten practice, practice in turn should be of use to science. Physicians thoroughly imbued with these ideas will always keep their interest in the progress of science, at the same time that they do their duty as practitioners. In noting accurately and acutely the interesting cases that present themselves,

they will understand how fully science may profit by them. Experimental scientific medicine will thus become the achievement of us all; and every one of us, *even if he be only a simple country doctor,* will make his own useful contribution.

DISCUSSION

John Oppie McCall, New York City: There are two points in Dr. Zemsky's paper which I should like to touch on. The dental diagnostician, or dental internist, is constantly confronted with roentgenographic evidence of such conditions as those Dr. Zemsky has described, and must decide whether to recommend operative interference. This question cannot be answered solely on the basis of infection, as might at first glance seem to be the case. For one thing, the presence of infection of a chronic nature does not invariably lead to metastatic disease. Furthermore, the elimination of chronic infection does not seem to be invariably beneficial to the patient, at least according to many reports of cases so treated. It becomes necessary then to evaluate imbedded roots, impacted teeth, etc., on some broader basis than that of infection only. And it is here that the general practitioner, as Dr. Zemsky has said, enters the picture in a rôle which is potentially very important. For laboratory studies, whether bacteriologic or histologic, can only answer one question and that is, "Was infection present?" We have still to find out what the patient's present state of health is, his health history, the family health history, the blood picture both cytologic and chemical, and other items bearing on the case which must contribute toward the answer as to whether to operate. The central factor in Dr. Zemsky's paper has to do with the enlistment of the general practitioner in a proposed clinical research. Dr. Zemsky, in introducing his thought, brings out a point which has been too little considered in past study of oral infections and abnormalities; namely, the ultimate effect on the patient of removal of imbedded roots and other possible foci of infection. We hear much of the immediate effects of such operations, some favorable, some negative. But how are we to know that favorable effects persist or, on the other hand, that negative results do not in time become positive, thus proving the operation to have been beneficial? The general practitioner is, in most cases, the only one who can answer this question. To make a serious, continuing and accurate study of the results of operations constitutes research just as real and just as valuable as any study conducted in a laboratory. Like laboratory research, it requires a certain capability, an interest in the object of the research and a willingness to do a certain amount of unremunerative and often uninteresting work. Because of the fact that research is usually carried out in a laboratory and that such work usually requires highly specialized training on the part of those who carry it on, the very word "research" has come to be endowed with mystery, and it has come to be an accepted tenet that but few people are capable of doing research work. Neither of these things is necessarily true, and it therefore is possible to state unequivocally that a large percentage of the general practitioners of dentistry are capable of doing some type of research work. Particularly is this true of the clinical research that Dr. Zemsky proposes. What is needed for this kind of research is nothing more nor less than the ability to make accurate, complete and unbiased observations of the clinical facts presented in each case under study and the patience to record the findings of each case in a systematic and homologous manner. Let us next inquire as to whether records so made are to be considered as constituting reliable scientific evidence on the subject of the research; for unless the results can be accepted as reliable, the labor of getting the information together will have been in vain. What are the conditions which bear on the question of reliability? First, we have the very serious question of the variability of the persons to be studied. A thousand and one factors enter into the make-up of the individual and his reactions to his environment. He may be affected by one or more of a wide variety of diseases, and even a single disease may affect different persons in different ways. This wide variability of the effects of various combinations of disease conditions might seem at first glance to end at once any consideration of the possibility of doing reliable clinical research work in any field whatever. Such is not the case. For instance, the variability of persons as regards length of life does not preclude the development of accurate life expectancy tables such as are used by life insurance companies for computing their premium rates. These tables are accurate for the reason that they are based on a compilation of a large number of cases; and when variables are spread out over a sufficiently large number of

cases, the average behavior can be estimated with considerable accuracy. This is the answer to the basic difficulty in Dr. Zemsky's proposal. Granted that the collection of data on a sufficient number of cases will make it possible to draw reliable conclusions, we are then confronted with another difficulty, the possible variation in the observations of different dentists. Will two different dentists see the same thing in the same way and draw the same conclusions from it? This question is perhaps harder to answer. But the difficulty is not insurmountable. A reasonable uniformity can be attained by setting up comprehensive objective standards which may serve as the criteria for the observations. It then remains to select dentists for the study whose experience in practice gives promise of their being able to utilize these standards. The last step is to develop an organization for enrolling dentists who are willing to take part in the research and to collect and tabulate the reports received. If the profession believes, as I do, that this research is important, this last step will be taken without delay.

FURTHER STUDIES ON THE RECOGNITION OF B. ACIDOPHILUS*

By FAITH P. HADLEY, M.S., and R. W. BUNTING, D.D.Sc., Ann Arbor, Mich.

IN the present controversy regarding the etiology of dental caries, definite information regarding the presence or absence of *B. acidophilus* in the mouths of caries-susceptible as contrasted with caries-free individuals is of great importance.

Early studies on this point convinced us,[1] as it has convinced others, that *B. acidophilus* was closely associated with the carious lesions and that the organism was commonly absent from mouths that were free from caries. In our first publication on this subject, in 1925, we reported a 100 per cent correlation between the existence of caries and the presence of *B. acidophilus* in the mouth. At the same time, we reported that only three of a group of nineteen caries-free individuals showed *B. acidophilus*. At a later date, Bunting, Nickerson and Hard[2] reported that 98 per cent of 243 cases of caries were positive for *B. acidophilus*, whereas in only one of 184 caries-free individuals was the culture positive. In 1927, Jay and Voorhees,[3] in an independent study, reported that only four of fourteen caries-free patients showed the presence of *B. acidophilus*, and that, of these four, three developed caries within a few months.

In attempting to explain the diminished frequency of *B. acidophilus* in caries-free individuals, the question arose as to whether *B. acidophilus* might be present in these cases, but in a form or stage

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*Read before the Section on Histology, Physiology, Pathology, Bacteriology and Chemistry (Research) at the Seventy-Third Annual Session of the American Dental Association, Memphis, Tenn., Oct. 21, 1931.

1. Bunting, R. W., and Palmerlee, Faith: Rôle of Bacillus Acidophilus in Dental Caries, J.A.D.A., 12:381 (March) 1925.

2. Bunting, R. W.; Nickerson, Gail, and Hard, Dorothy G.: Dent. Cosmos, 68:931 (Oct.) 1926.

3. Jay, Philip, and Voorhees, R. S.: Dent. Cosmos, 69:977 (Oct.) 1927.

which was not detected by our usual methods of cultivation and identification. In other words, were there present atypical forms, perhaps forms of the true *B. acidophilus,* which were not identified as such, either by ourselves or others, in earlier work?

Accordingly, there was first carried out a study of all the types and stages possible of discovery in the development of this organism. Several types, revealing distinct differences one from another, were discovered, and these have been described and illustrated in a recent publication.[4] It was concluded that there existed several atypical forms, unquestionably phases in the life history of *B. acidophilus,* but so different in structure or colony formation that failure to discover them in earlier investigations was easily understandable.

On reviewing our earlier studies, it also seemed possible that the failure to discover *B. acidophilus* in a larger percentage of caries-free mouths might have been due to the small number of examinations of each case. We did not know whether the absence of the organism on one day signified its continued absence; and it seemed possible that more frequent examinations, either of saliva or of scrapings from the teeth, might have revealed *B. acidophilus* in a larger number of caries-free cases.

Since it seemed important to facilitate in every way possible the discovery of *B. acidophilus* in the mouths of caries-free patients, if the organism really existed there, this study has been extended to other groups. The present report, therefore, deals with a comparative study of the occurrence of the acidophilus organism in caries-susceptible and in caries-free mouths. It also reveals the frequency with which the definite types of *B. acidophilus* are found in these two groups. In addition, the frequency of occurrence of the organism and its variants in the intestinal tract of these individuals has received study.

TABLE 1.—FREQUENCY OF ISOLATION OF B. ACIDOPHILUS FROM DIFFERENT LOCATIONS IN CARIES-SUSCEPTIBLE AND CARIES-FREE INDIVIDUALS

Caries-Susceptible: Nine Cases						Caries-Free: Seven Cases					
		Positive		Negative				Positive		Negative	
No. of Cultures	Location	No. +	% +	No. −	% −	No. of Cultures	Location	No. +	% +	No. −	% −
44	Tooth Surface	44	100	0	0	22	Tooth Surface	10	45	12	55
34	Saliva	34	100	0	0	28	Saliva	22	78	6	22
39	Feces	39	100	0	0	31	Feces	20	65	11	35

MATERIAL AND METHODS

Nine individuals who were found to be susceptible to caries, as shown by careful clinical examinations, were selected.

4. Hadley, Faith P.; Bunting, R. W., and Delves, Edna: Recognition of Bacillus Acidophilus Associated with Dental Caries. Preliminary Report, J.A.D.A., 17:2041 (Nov.) 1930.

Seven other individuals were selected who had always been free from caries. The ages of these two groups ranged from 17 to 24 years. Daily cultures were made, for five successive days, from each of the following locations and by the following methods:

1. *Teeth.*—Scrapings from the surfaces of many teeth, both upper and lower, were inoculated into 1 per cent glucose infusion broth having a reaction of p_H 5.0.

2. *Saliva.*—From six to eight drops of saliva, obtained by the chewing of paraffin, was inoculated into a tube of the same medium.

3. *Feces.*—A small amount of a fresh sample was emulsified in 0.85 per cent salt solution, and a few drops of the emulsion added to a tube of the same medium.

All cultures were incubated at 37 C. for four days, after which stained smears were made (Gram stain) and examined. At the same time, plates of casein digest-sodium oleate-agar were streaked. These plates were incubated for three days at 37 C. and then examined for *B. acidophilus* and its different colony types. Stained preparations were made from the various colonies and single colonies were subcultured to tubes of glucose infusion broth having a reaction of p_H 6.2, in order to study the growth characteristics and to ascertain the degree of acid formation. In the results reported below, a positive culture means that some form of *B. acidophilus* was detected on the agar plates. Occasionally, the primary broth culture was found to contain a few rod forms which failed to grow on the agar. In such cases, the results were regarded as negative. In this manner, the following points were studied:

1. *Does B. acidophilus always appear in the mouth or intestinal tract in one form, or may it appear in several forms?* There is a general agreement among those who have studied *B. acidophilus* in the mouth that at least two types of the organism may be present. McIntosh and

TABLE 2.—FREQUENCY OF ISOLATION OF VARIOUS TYPES OF B. ACIDOPHILUS FROM DIFFERENT LOCATIONS IN CARIES-SUSCEPTIBLE AND CARIES-FREE INDIVIDUALS

Caries-Susceptible												Caries-Free											
No. of Positive Cultures	Location	Number and Percentage of Cultures Giving Following Types*										No. of Positive Cultures	Location	Number and Percentage of Cultures Giving Following Types*									
		1		2		3		4		?				1		2		3		4		?	
		No.	%	No.	%	No.	%	No.	%	No.	%			No.	%	No.	%	No.	%	No.	%	No.	%
44	Tooth Surface	27	61	8	18	29	66	3	7	0	0	10	Tooth Surface	6	60	1	10	2	20	0	0	4	40
34	Saliva	20	60	9	26	27	80	2	6	0	0	22	Saliva	19	86	1	4	4	18	0	0	7	31
39	Feces	23	60	14	36	24	61	3	8	3	8	20	Feces	11	55	3	15	6	30	1	5	10	50

*Many cultures contained two or more types of B. acidophilus. The figures given are stated in percentage of occurrence of each strain in the positive cultures.

TABLE 3.—FREQUENCY OF OCCURRENCE OF VARIOUS TYPES OF B. ACIDOPHILUS IN CARIES-SUSCEPTIBLE INDIVIDUALS

	Days	Tooth Surface					Saliva					Feces				
		1	2	3	4	?	1	2	3	4	?	1	2	3	4	?
Case 2	1	+		+			Not cultured						+	+		+
	2	+		+					+				+	+		
	3			+				+	+				+			+
	4		+	+				+	+				+	+		
	5		+	+				+	+				+	+		
Case 3	1	+			+		Not cultured					Not cultured				
	2	+			+		+					+				
	3	+					+		+			+	+			
	4		+	+					+					+		
	5	+					+					Not cultured				
Case 4	1		+	+			Not cultured					+		+		
	2		+	+				+	+				+	+		
	3		+	+				+	+					+		
	4	+							+					+		
	5	+		+			+		+			+				
Case 5	1	+		+			Not cultured					+	+	+		
	2	+		+			+		+			+		+		
	3	+		+			+		+			+	+			
	4		+					+	+				+	+		
	5	+	+				+	+				+			+	
Case 6	1	+		+			Not cultured					+		+		
	2	+					+		+			+		+		
	3			+			+		+				+			
	4	+		+			+		+			+		+		
	5	+		+			+		+			+	+			
Case 7	1			+			Not cultured							+		
	2			+					+					+	+	
	3	Not cultured					Not cultured					Not cultured				
	4			+					+					+		
	5			+	+				+	+				+	+	
Case 8	1			+			Not cultured					+	+			
	2			+			+	+					Not cultured			
	3			+				+	+			+		+		
	4	+					+		+	+		+		+		
	5	+					+		+				Not cultured			
Case 9	1	+		+			Not cultured						+	+		
	2			+					+			+				
	3	+					+					+				
	4	+					+					+				
	5	+		+			+		+			+		+		
Case 10	1	+					Not cultured					+				
	2	+					Not cultured						Not cultured			
	3	+					+		+			+				+
	4	+		+			+		+			+		+		
	5	+		+			+					+				
Totals		27	8	29	3	0	20	9	27	2	0	23	14	24	3	3

his collaborators,[5] also Rodriguez,[6] first pointed out a morphologic difference between these two types. Subsequently, we studied them in detail from cultural and dissociative standpoints, and we concluded that at least four distinct types could be detected in the mouth. These were described, differentiated from one another and illustrated by photomicrographs in a recent publication.[4] The

TABLE 4.—FREQUENCY OF OCCURRENCE OF VARIOUS TYPES OF B. ACIDOPHILUS IN CARIES-FREE INDIVIDUALS

	Days	Tooth Surface					Saliva					Feces				
		1	2	3	4	?	1	2	3	4	?	1	2	3	4	?
Case 1	1	Negative					Not cultured					+		+		
	2	Negative					Negative					Negative				
	3	Negative					Negative					Negative				
	4	Negative					Negative					Negative				
	5	Negative					Negative					Negative				
Case 11	1	+		+								Negative				
	2	+	+				+	+				Negative				
	3	Negative									+	Negative				
	4	Not cultured					Not cultured					Not cultured				
	5	+					+				+	Negative				
Case 13	1	Not cultured					Not cultured					+				+
	2	+				+	+				+					+
	3					+					+					+
	4					+	+				+					+
	5	+					+				+		+			+
Case 14	1	Not cultured					Not cultured					+				
	2	+					Negative						Not cultured			
	3	Negative					+					+		+		
	4		+				+					+				
	5	Negative					+						Not cultured			
Case 15	1	Negative					Not cultured					Negative				
	2	Negative					+									+
	3	Negative					Not cultured					+				+
	4	Negative					Negative					+				
	5					+					+					+
Case 16	1	Not cultured					+									+
	2	Not cultured					+					+				+
	3	Not cultured					+						Negative			
	4	Not cultured					+						Negative			
	5	Not cultured					+						Not cultured			
Case 17	1	Not cultured					+		+			+		+		
	2	Not cultured					+					+		+		
	3	Not cultured					+		+			+		+		
	4	Not cultured					+		+			+		+		
	5	Not cultured					+		+			+		+		
Totals		6	1	2	0	4	19	1	4	0	7	11	3	6	1	10

5. McIntosh, J.; James, Warwick, and Lazarus-Barlow, P.: Brit. Dent. J., 43:728 (Aug. 1) 1922.

6. Rodriguez, F. E.: Mil. Dent. J., 5:199 (Dec.) 1922.

chief distinguishing features were as follows:

Type 1: Smooth colony, round, convex, opaque; bacilli short, almost coccoid, appearing as chains in broth; often curved rods with concave sides of two rods opposing one another.

Type 2: Smooth colony, round, opaque, convex; bacilli straight and longer than Type1; no chain formation in broth, but showing a parallel arrangement.

Type 3: Intermediate colony, slightly irregular, flat, translucent; rods thick and blunt, varying from short to long forms; no chain formation nor parallel groupings conspicuous; colony form the chief characteristic of the type.

Type 4: Rough colony, larger than Types 1, 2 and 3; irregular, thin flat, transparent, rough surface with very filamentous border; bacilli thick; often long winding filaments; "curled" and "wavy" forms.

Types 1, 2 and 3 can be dissociated *in vitro* into Type 4.

Regarding the appearance of these types in cultures from the intestinal tract, it has been implied in certain publications[7] that Type 4 (the "rough" form) is the type of *B. acidophilus* especially characteristic of this location. In the present study of cultures from feces of seventeen individuals, all four types were observed as shown in Table 2. We conclude that there is no single form in which *B. acidophilus* appears, either in the mouth or in the intestines.

2. *Do individuals which caries differ from caries-free individuals in respect to the presence or absence of B. acidophilus on tooth surfaces or in saliva or feces?* (Table 1.)

Tooth surfaces: Of forty-four cultures taken from tooth surfaces of nine susceptible mouths, 100 per cent were positive for *B. acidophilus*. Of twenty-two cultures from tooth surfaces of seven caries-free mouths, ten, or 45 per cent, were positive.

Saliva: Of thirty-four cultures taken from saliva of nine susceptible cases, 100 per cent were positive. Of twenty-eight cultures of saliva from caries-free mouths, twenty-two, or 78 per cent, were positive.

Feces: Of thirty-nine cultures from feces of caries-susceptible individuals 100 per cent were positive. Of thirty-one cultures of feces of caries-free individuals, only twenty, or 65 per cent, were positive for *B. acidophilus*.

From these results, as far as they go, it appears that *B. acidophilus* was invariably present in the saliva, on the teeth and in the intestinal tract of individuals in whom caries is active. In caries-free cases, on the contrary, although the percentage of occurrence of *B. acidophilus* in the saliva was high (78 per cent), the occurrence of localization on the teeth was relatively low (45 per cent), compared with 100 per cent localization on teeth in the mouths containing caries. This is a point of considerable interest, an explanation of which is not at present available.

In addition, with reference to the occurrence of *B. acidophilus* in the intestinal tract, it is clear that, in the caries-free cases, it was somewhat lower (65 per cent) than the 100 per cent occurrence in those with active caries.

It must be understood that all the data herewith submitted are based on qualitative examinations of the oral cavity and the feces. It is very possible that if adequate methods of quantitative estimation of the degree of *B. acidophilus* overgrowths were available, a marked difference might be observed between the

7. Kulp, W. L.: J.A.M.A., 87:833 (Sept. 11) 1926.

number of acidophilus organisms in the caries-free and in the caries-susceptible individuals. Therefore, although positive qualitative cultures have been reported from a considerable number of apparently caries-free individuals, it is possible that the amount and degree of activity of these organisms may be considerably less than that which occurs in caries-susceptible cases. The fact that repeated cultures of caries-free mouths frequently vary from positive to negative (Table 4) suggests that the number of acidophilus organisms may be so small that they are insignificant.

3. *In those susceptible to dental caries, what is the most common type of B. acidophilus observed in the various locations studied?* (Table 2.)

Tooth surfaces: Type 1 was present in 61 per cent of cultures, Type 2 in 18 per cent, Type 3 in 66 per cent and Type 4 in 7 per cent. The predominance of Types 1 and 3 is obvious. (Table 2 footnote.)

Saliva: Type 1 was present in 60 per cent of cultures, Type 2 in 26 per cent, Type 3 in 80 per cent and Type 4 in 6 per cent. Again, we observe the predominance of Types 1 and 3.

Feces: Type 1 was present in 60 per cent of cultures, Type 2 in 36 per cent, Type 3 in 61 per cent and Type 4 in 8 per cent. Again, Types 1 and 3 predominate in this location. In three (8 per cent) of the cultures, an unidentified, gram-positive bacillus was found. This will be mentioned again later.

Summarizing these data, it appears that, irrespective of source, it is the Type 1 (smooth) and Type 3 (intermediate) that occur most frequently in those individuals in whom caries is active, while the "rough" forms are comparatively rare. It appears, in addition, that the same smooth and intermediate strains, characteristic of the oral flora, are also the most common types in the intestinal tract, there being a striking continuity of type. This is in opposition to the views of recent writers who have regarded the "rough" type as characterizing the intestinal strains of *B. acidophilus*.

4. *In those free from dental caries, what is the most common type of B. acidophilus in the various locations examined?* (Table 2.)

Tooth surfaces: Type 1 was present in 60 per cent of cultures examined; Type 2 in 10 per cent, Type 3 in 20 per cent, and Type 4 in none of the cultures. In these cases, there was observed, in addition to the types mentioned, another which possessed the colony characters of Type 1, but the morphologic features of Type 3. This unknown type was observed in 40 per cent of cultures from the caries-free group. But, what appears of greater interest, it was found not at all in the susceptible group.

Saliva: Type 1 was present in 86 per cent of cultures, Type 2 in 4 per cent, Type 3 in 18 per cent, and Type 4 not at all. The "unidentified type" was present in 31 per cent. Types 1 and the "unidentified" were, therefore, the predominant forms.

Feces: Type 1 was present in 55 per cent of cultures, Type 2 in 15 per cent, Type 3 in 30 per cent and Type 4 in 5 per cent. The "unidentified" form was present in 50 per cent of the cultures. The distribution of types in the feces thus appeared to run almost parallel to those of the mouth, Types 1 and the "unidentified type" being the most common.

From the data here reported, it appears that, in the caries-free group, a similar distribution of types occurred in the three sources. In all cases, Type 1 and the "unidentified" were the most common, just as Types 1 and 3 were the most

common in the susceptible group. The most striking point in these examinations is the presence in the caries-free group of an acidophilus-like organism of a special type which was found only three times (feces) in the susceptible group; also, the diminished frequency of Type 3 strains in the immune group. At present, we have no explanation to offer for these differences.

5. *Is there a tendency for all the types of B. acidophilus to be present in any one location in any one individual?*

As may be seen in Tables 3 and 4, all four types were seldom found in one location in one person, although it often happened that Types 1, 2 and 3 were present successively during the five days in which cultures were taken. These three types were seldom found in any one culture. This held true for all three locations: tooth surfaces, saliva and feces. There was a marked tendency for Types 1 and 3 to appear together in a given location, especially in the patients of the susceptible group.

6. *Is there a tendency for one or another type of B. acidophilus to be duplicated in one individual in the three locations?* (Tables 3 and 4.)

Frequently, the same types were isolated from all locations in the same individual. For instance, Case 4 (caries-susceptible) revealed Types 1, 2 and 3 from tooth surfaces, saliva and feces. Case 7 (caries-susceptible) showed only Types 3 and 4 in these locations. Case 10 (caries-susceptible) gave Types 1 and 3 only.

In the caries-free group, the presence of Type 1 in the mouth usually indicated the presence of the same type in the feces. The "unidentified" form, moreover, was never found in the mouth when it was not also present in the feces.

From this, and from other instances appearing in the tables, it appears that there was a clear tendency for the types to be duplicated in the three locations in the same individual.

CONCLUSIONS

In reviewing the chief results obtained from this study, we believe the following facts to be significant:

1. There was demonstrated a clear difference in the bacterial flora of the mouths of caries-susceptible and caries-free individuals with reference to *B. acidophilus.* This difference was revealed in four ways: (*a*) the diminished frequency of occurrence of *B. acidophilus* in the caries-free groups; (*b*) the qualitative differences in the types of *B. acidophilus* isolated; (*c*) the diminished frequency of localization on tooth surfaces in the caries-free group, and (*d*) the presence in the caries-free group of a type of organism rarely encountered in the susceptible group.

2. It was demonstrated further that when a certain type of *B. acidophilus* was predominant on the tooth surfaces, there was a tendency for these same types to be present in the saliva. In caries-susceptible mouths, the predominant forms were Types 1 and 3. In caries-free mouths, the predominant forms were Type 1 and the unidentified type mentioned earlier.

3. It was clearly shown that the findings in the mouth, with reference to the presence of *B. acidophilus,* and with reference to the types of organism present, were duplicated to a marked degree in the intestinal tract. This can lead only to a conception of the existence of a continuity of infection in the mouth and the intestines.

4. One of the outstanding results of

this study is the increased number of positive cultures from the tooth surfaces of the caries-free individuals over that previously reported. As pointed out above, this may have two explanations: (*a*) in the earlier studies, atypical forms of *B. acidophilus* were not recorded as positive, and (*b*) in the present study, a larger number of examinations were made from each case. It must be borne in mind that in the group of positive, caries-free cases recently studied, the organism was seldom uniformly present, and usually appeared to be inconstant and sporadic in its occurrence. In addition to this, it may be possible that a subsequent clinical examination, which will be given in the near future, will reveal, as in Jay's early work, the beginning of active caries.

We realize that the number of cases in the two groups studied has been small; but, at this stage in our investigations, we believe that results obtained from a detailed study of small groups may afford more valuable information than results on larger groups more superficially examined. The results already obtained appear to warrant the application of similar methods of attack to other groups. It is possible that, when adequate quantitative methods of determining the extent of activity of this organism shall be available, the relationship of *B. acidophilus* to dental caries may be more clearly demonstrable.

INLAY CASTING GOLDS: PHYSICAL PROPERTIES AND SPECIFICATIONS*

By N. O. TAYLOR,† Ph.D., GEORGE C. PAFFENBARGER,‡ D.D.S., and W. T. SWEENEY,§ A.B., Washington, D.C.

STUDIES of the properties of inlay casting golds and of the accessory materials used in the dental casting processes were undertaken as part of the cooperative work on dental materials by the Bureau of Standards and the American Dental Association. The data secured were of use in the analysis and development of practical casting technics. Reports have been presented on the characteristics of the accessory materials entering into the casting process.[1] This report includes descriptions of the work done on casting golds which are intended primarily for use in the production of

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1. Taylor, N. O., and Paffenbarger, G. C.: Survey of Current Inlay Casting Technics, J.A.D.A., 17:2058 (Nov.) 1930; Taylor, N. C.; Paffenbarger, G. C., and Sweeney, W. T.: Dental Inlay Casting Investments, ibid, 17: 2266 (Dec.) 1930; Specification for Inlay Casting Wax, ibid., 18:40 (Jan.) 1931; Specification for Dental Impression Compound, ibid., 18:53 (Jan.) 1931.

inlays, the test methods used, the data secured and discussions of these data.

PREVIOUS WORK

R. L. Coleman[2] reported the compositions and properties of a series of casting golds as determined at the Bureau of Standards. He also developed and described test methods for use in determining the properties of this type of material. The test methods and the equipment described by Coleman have been used to a large extent in this study.

In 1928, Wilmer Souder[3] first suggested physical and chemical requirements for dental alloys. These requirements were drafted as a result of (1) a study of the alloys recommended and

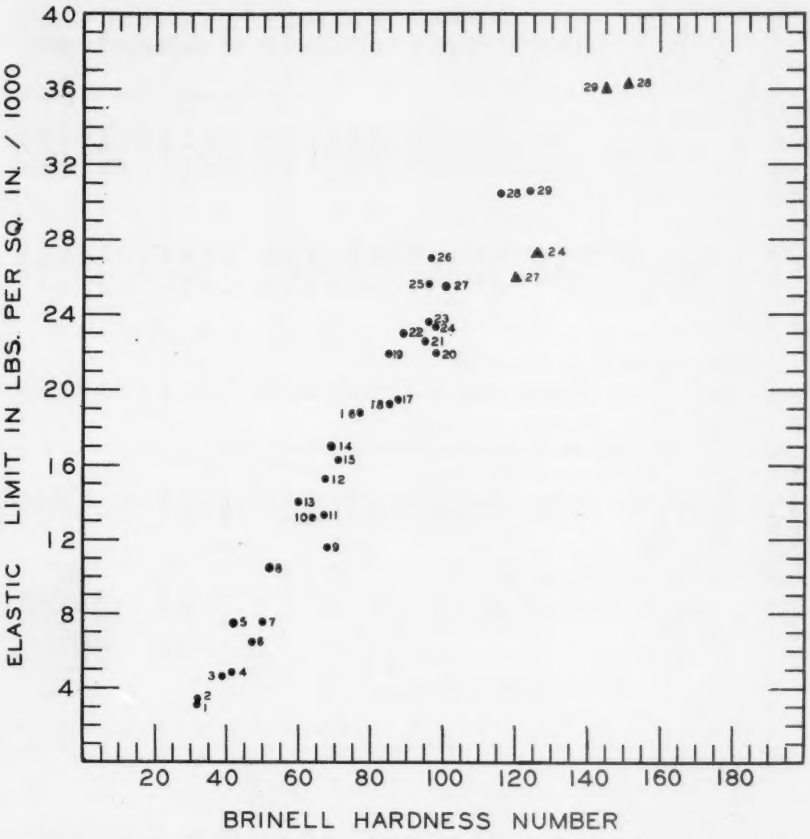

Fig. 1.—Relation of values for Brinell number and proportional limit of inlay casting golds.

2. Coleman, R. L.: Physical Properties of Dental Materials, Bur. Standards J. Res., December, 1928, p. 867.

3. Souder, Wilmer: Summary of Reports on Dental Materials, J.A.D.A., 15:627 (April) 1928.

TABLE 1.—PROPERTIES OF GOLD ALLOYS FOR CAST INLAYS*

Alloy Composition % by Wt.			Fusion Range Degrees F.	Melting Point (Wire Method) Degrees F.	Castings Quenched from 1290 F.				Brinell No. (Oven Cooled) Reheated to 842 F. and Cooled to 482 F. in 30 Minutes
Type or Use No.	Gold and Platinum Group	Silver			Brinell No. †	Elastic Limit Lbs. per Sq. In.‡	Ultimate Strength Lbs. per Sq. In.#	% Elongation 2 In. Gage Length#	
1	100.0	.....	.....	1987	33	3,000	16,000	18.5	34
2	95.0	4.0	.....	1904	32	3,500	16,500	14.5	34
3	87.8	11.2	.....	1881	39	4,500	25,500	25.5	38
Soft Inlays									
4	95.0	3.5	.....	1884	42	5,000	23,000	23.5	38
5	91.4	5.8	.....	1827	42	7,500	25,000	16.5	.....
6	89.8	8.1	.....	1850	47	6,500	27,000	21.0	46
7	91.5	5.7	.....	1834	50	7,500	31,000	24.5	47
8	90.8	4.0	.....	1783	52	10,500	28,000	17.5	.....
9	90.1	5.3	1812–1751	1778	68	11,500	35,000	24.5	64
10	89.5	6.2	.....	1812	63	13,500	34,000	19.0	59
11	82.9	12.0	.....	1753	67	13,500	36,500	26.0	64
12	82.4	11.6	.....	1746	67	15,500	39,500	25.5	67
13	87.8	6.8	.....	1758	60	14,000	38,500	22.5	59
14	90.1	.4	.....	1729	69	17,000	33,500	16.0	.....
15	83.2	10.1	.....	1739	71	16,000	38,000	18.0	75
Medium Inlays									
16	83.3	8.3	.....	1686	77	19,000	38,500	26.0	91
17	83.2	11.0	.....	1735	88	19,500	36,500	11.0	97
18	81.3	9.3	1702–1627	1650	85	19,500	46,000	30.5	88
19	84.4	10.0	1872–1731	1791	85	22,000	45,500	18.5	87
20	85.7	7.1	.....	1767	98	22,000	49,500	22.0	110
21§	80.2	13.0	.....	1738	95	22,500	46,500	21.0	119
22	83.0	9.1	1830–1704	1753	89	23,000	43,000	10.5	104
23	73 9	17.3	1782–1679¶	1679	96	23,500	41,000	21.5	106
24	84.7	7.5	.....	1746	98	23,500	41,000	11.0	126
25	79.0	14.4	.....	1789	96	25,500	45,500	10.0	117
26	83.4	9.0	1830–1704	1728	97	27,000	46,500	15.0	108

Hard Inlays									
27§	84.1	7.0	1828–1690	1756	101	25,500	48,000	16.5	120
28§	80.2	12.7	.....	1708	116	30,500	51,500	11.5	151
29§	79.5	9.3	1735–1656	1693	124	30,500	47,500	12.5	145
30§**	75.5	9.4	1740–1616	1663	149	41,000	57,000	5.5	205

*Values for physical properties other than fusion range or point represent averages of three or more samples.

†One-sixteenth-inch ball; 12.6 kg. load.

‡Load at which deformation rate equals or exceeds 1.25 times original rate.

/Obtained by slow and continuous loading.

¶Alloy formula changed after original tests were made. The fusion sample had the following composition: gold and platinum group, 74.8 per cent; silver, 20.2 per cent.

§See attached table for properties of oven cooled specimens.

**Primarily a denture gold—not an inlay gold.

used by reserve officers of the Army Dental Corps, (2) a study of the physical properties essential to their use in dentistry and (3) the work on gold alloys previously mentioned. They were adopted by several of the government departments as specifications for use in their purchases of gold alloys. This report covered seven classes of wrought and casting golds. The present study was directed toward materials which fell into the first two groups of this original classification, namely, those golds intended for soft and those intended for hard inlay castings. A study of commercial wrought alloys for clasps and for use in orthodontia is now in progress. The present program of cooperative work calls for studies of the other types of gold alloys to be undertaken in the near future.

SELECTION OF ALLOYS FOR TEST

The samples of casting golds whose properties were studied and reported at this time were obtained under loan agreements with several manufacturers; which permitted samples to be secured from the stocks available in various supply houses throughout the country on memorandum receipt, all scrap being returned direct to the manufacturers and payment being made for unavoidable losses in case bills were rendered for such losses. The firms supplying samples under these agreements were Julius Aderer, Inc., Thos. J. Dee & Co., Goldsmith Bros. S. & R. Co., J. F. Jelenko & Co., Inc., The J. M. Ney Company, Patterson Hettinger Co., Spyco S. & R. Co., Vernon Benshoff Co., The Wilkinson Co., Williams Gold Refining Co. and S. S. White Dental Mfg. Co.

Manufacturers were asked to designate those products which they felt to be best suited for the production of soft and hard inlays. It soon became evident that the alloys which were suggested for these

uses could best be divided into four rather than two groups. As the study progressed, it further became evident that one of these groups could be replaced to advantage by alloys in an adjoining classification, as will be explained later. One of the samples secured should not be considered as an inlay gold, its primary use being that of a one-piece casting gold. Its properties are included in the tabulated data as an item of general information.

The samples submitted were all yellow or "gold" color alloys, no "white" golds being included in the group tested.

TABLE 2.—PROPERTIES OF OVEN COOLED* ALLOYS

Alloy	Brinell No.	Elastic Limit Lbs. per Sq. In.	Ultimate Strength Lbs. per Sq. In.	% Elongation 2 In. Gage
21	119	27,500	56,000	7.5
27	120	26,000	48,000	12.0
28	151	36,500	62,000	1.5
29	145	36,000	55,000	3.5
30	205	69,000	94,000	1.0

* Quenched from 1290 F.; reheated to 842 F., and cooled to 482 F. in thirty minutes.

TABLE 3.—DETAIL REQUIREMENTS FOR DENTAL INLAY CASTING GOLDS (GOLD COLOR)

Type	Gold and Platinum Group Metals, Per Cent	Silver, Per Cent	Brinell Number	Elongation, 2 In. Gage Length, Per Cent	Yield Point, Lbs. per Sq. In.	Fusion Temperature, Degrees F.
	Minimum	Min.—Max.	Min.—Max.	Minimum	Minimum	Minimum
A	83	3—12	40— 75	18	.....	1725
B	78	0—15	70—100	12*	22,000	1650
C	78	0—15	90—140	12*	27,000	1650

* This value shall be reduced 0.5 per cent for each 1 per cent of platinum group metals in the alloy, and 8 per cent shall be the minimum elongation allowed for any alloy.

TEST METHODS

The test methods used for the physical and chemical properties of the alloys are described below.

Chemical Composition.—The methods used for the analysis of the dental casting golds were those developed by W. H. Swanger of the Bureau of Standards.[4] These methods were followed with only very minor changes. In all cases in which elements were present in the alloy that would interfere with the precise determination of the element being estimated, the latter element was precipitated twice, as suggested in the paper.

A qualitative examination of the alloy was first made on a 1 gm. sample of material. The alloys were then analyzed in duplicate, 2 gm. samples being used for each analysis. The results given are the average of the two determinations on each constituent. If the element was pres-

4. Bur. Standards Scientific Paper No. 532, Analysis of Dental Gold Alloys.

ent in more than 1 per cent, these results were calculated to the first decimal place. All analyses were made by Aaron Isaacs, associate chemist, Bureau of Standards.

Physical Properties. — The physical properties of all alloys were determined on specimens which were softened by quenching from 700 C. (1292 F.). A few alloys were tested in the hardened condition as well.

Brinell Number.—The hardness numbers of the alloys were determined by the use of the Baby Brinell Hardness Testing Machine, described in previous reports. A load of 12.8 kg. was applied to the specimens through a one-sixteenth inch hardened steel ball and maintained for thirty seconds. The diameters of the depressions produced were measured after projection on the ground glass screen of a metallographic camera at a magnification of 100.

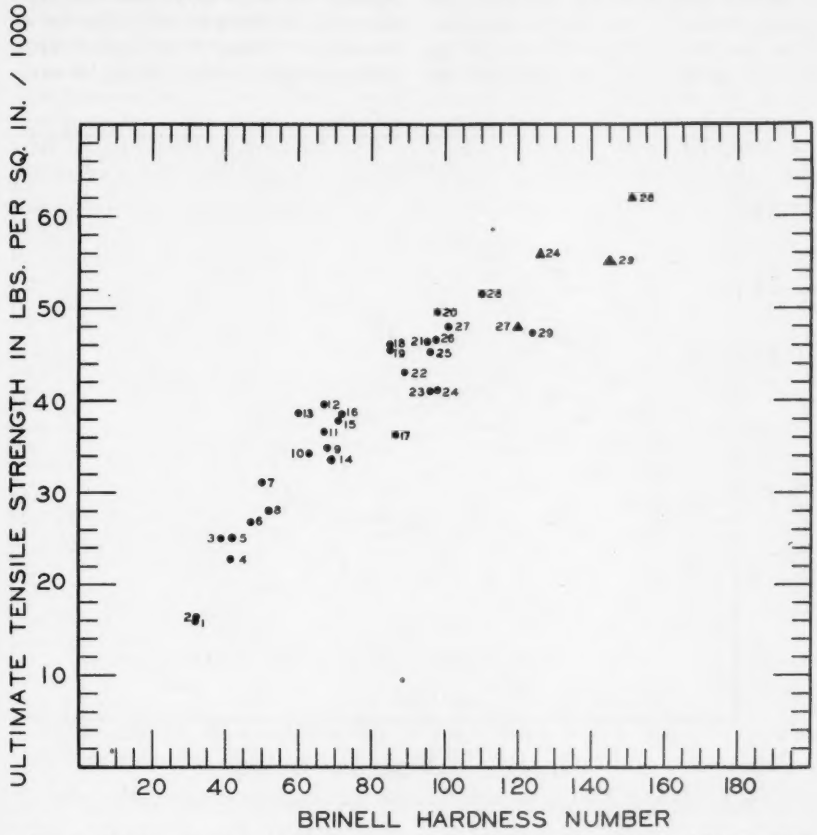

Fig. 2.—Relation of values for Brinell number and ultimate tensile strength of inlay casting golds.

The specimens for hardness tests were either small truncated cylindric cones with a base about 5 mm. in diameter or short sections cut from the ends of the specimens used for the tension tests.

At the conclusion of the tests, the standard load on the Baby Brinell machine was changed from 12.8 to 12.6 kg. to have the load used identical with the one-half of one Brinell number from the values obtained using the new load.

Tension Tests.—Cast samples approximately 0.085 inch in diameter and 5 inches long were tested in tension to determine the stress-strain relations, ultimate tensile strength and percentage of elongation. Loads were applied by a hand-operated Amsler testing machine

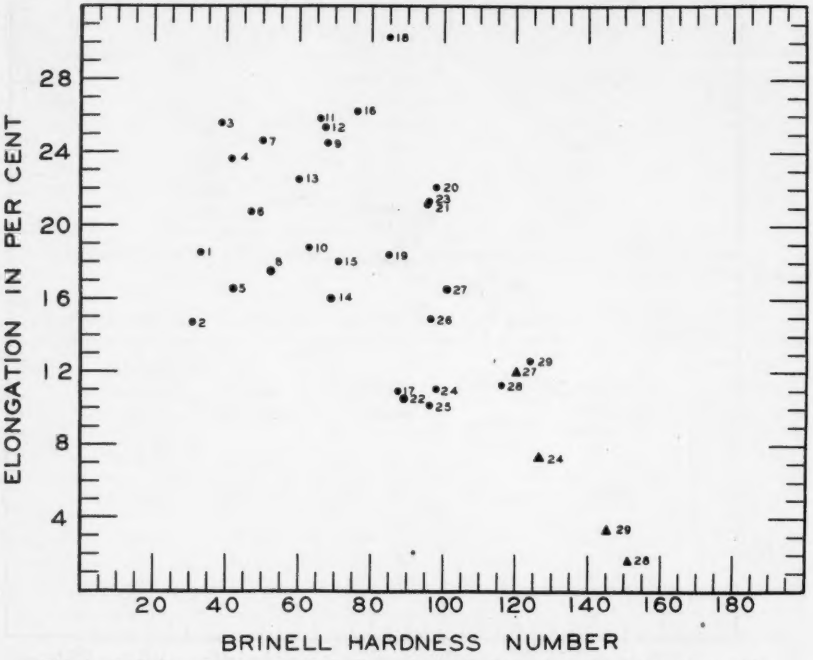

Fig. 3.—Relation of values for Brinell number and elongation of inlay casting golds.

value of that which should theoretically be used on a one-sixteenth inch diameter penetrator. (The 12.8 kg. load is correct for a 1.6 mm. ball, but it was found that the ball in common use for these tests was one-sixteenth inch.) The change was so small that hardness numbers of the alloys as observed would not vary more than which could be adjusted to give loads of 0-200, 0-400 and 0-600 pounds for a full scale movement of the indicator hands. The low ranges were used whenever possible to give increased accuracy in load settings.

Stress-strain data were obtained by the use of a double dial extensometer with

dials reading to one-ten thousandth inch and operating on a 3-inch gage length. Load increments of 1, 2 or 5 pounds were used as made advisable by the strengths of the various alloys. Loads were applied until permanent deformation was indicated and the extensometer was then removed. The data obtained are summarized in the table of physical properties under the term "elastic limit," which for purposes of this paper, is defined as the load at which the deformation produced by a unit load equals or exceeds

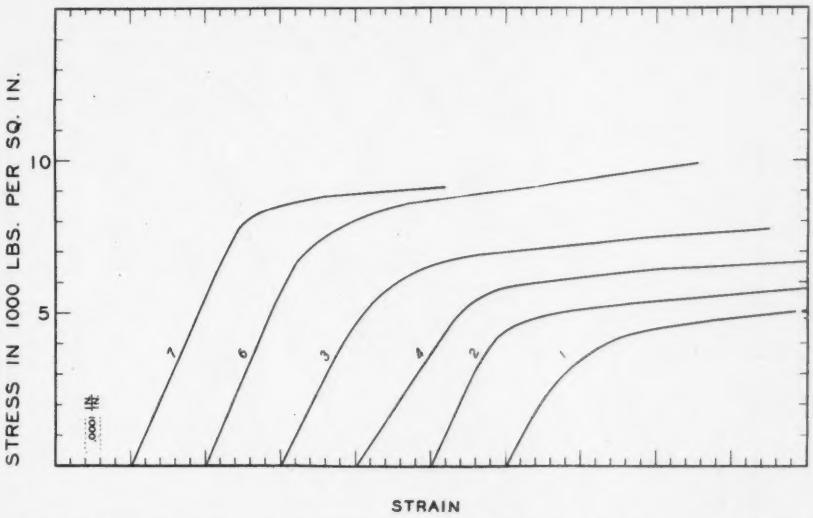

Fig. 4.—Average stress-strain diagrams for alloys Nos. 1, 2, 3, 4, 6 and 7 in softened condition; trade named alloys whose Brinell numbers were 50 or below.

1.25 times that first observed, and this value is given in pounds per square inch.

Ultimate Strength.—This was obtained by applying increasing loads to the samples slowly and continuously after the removal of the extensometer. The maximum loads recorded are given in pounds per square inch.

Percentage of Elongation.—This was determined over a 2-inch gage length, a Zeiss measuring microscope being used to measure the increase in length over the original 2 inches.

Casting Shrinkage.—The casting shrinkages of all of the alloys studied were not determined, laboratory data indicating that all types of dental casting golds had, when cast by the usual dental technics, casting shrinkages within the normal experimental error of the accepted value of 1.25 per cent.

Fusion Point (Wire Method) and Fusion Range.—Fusion temperatures by the wire method were determined on all the alloys tested. Manufacturers loaned large samples (300-360 dwt.) of several alloys for the determination of the fusion range from inverse rate cooling curves. These tests were made in the Pyrometry Section Laboratory of the Bureau. H. T. Wensel, W. F. Roeser, F. R. Caldwell and A. I. Dahl assisted in carrying out these tests.

EXPERIMENTAL RESULTS

The data obtained by the various tests are given in Tables 1 and 2.

SUMMARY OF DATA

The hardness of the inlay golds tested ranged between Brinell numbers 32 and 124 in the softened condition. The one exception was alloy No. 30, which was primarily a denture gold not of the group which would normally be used for inlays.

The elastic limits ranged from 3,000 to 30,500 pounds per square inch, while the ultimate strength values were between 16,000 and 51,500 pounds per square inch.

There were apparently definite relations between the hardness and elastic limit and the hardness and ultimate strength of the inlay golds tested. Figure 1 shows this relation for the hardness and elastic limit, and Figure 2 that for the hardness and tensile strength. In both cases, it is possible to draw straight lines representing the variation in the tensile properties with respect to the value for hardness and it will be found that, in the large majority of cases, a value for tensile strength or elastic limit calculated on the basis of the hardness number will agree with the data within the normal experimental error of the two determinations.

Similar plotting of the elongation data against hardness (Fig. 3) does not show

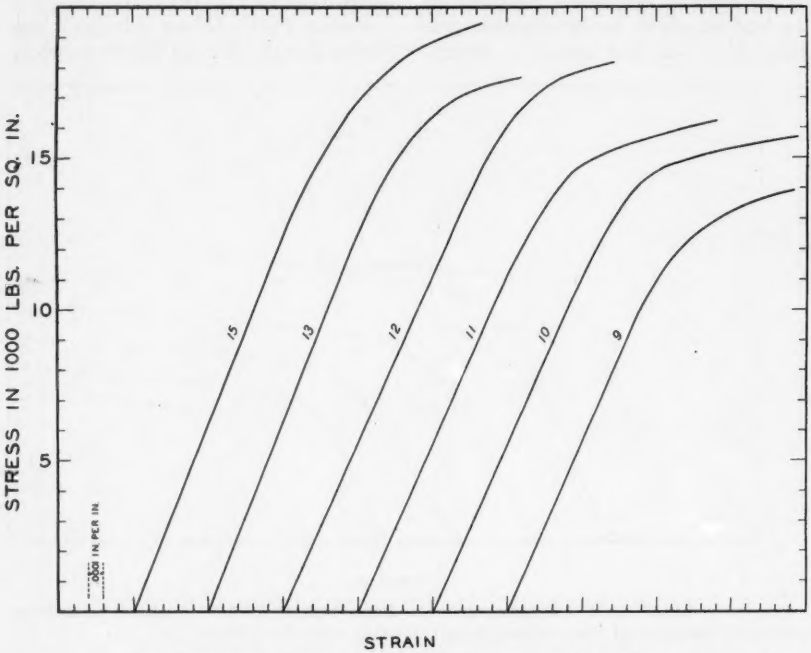

Fig. 5.—Average stress-strain diagrams for alloys Nos. 9-13 and 15 in softened condition; trade named alloys whose Brinell numbers were between 51 and 75.

so much regularity. Elongation values decrease to a marked degree with hardness numbers of 100 or over. The elongations determined for those very soft alloys are lower than those generally found for alloys having hardness numbers between 50 and 75. This is probably because of lack of uniform elongation throughout the gage length and also to a marked reduction in area in very short sections adjacent to the fracture. To express this in other words, we may say the hardening of these alloys by cold working at the point of incipient failure is not sufficient to enable them to withstand the added load and continue the elongation of adjacent sections.

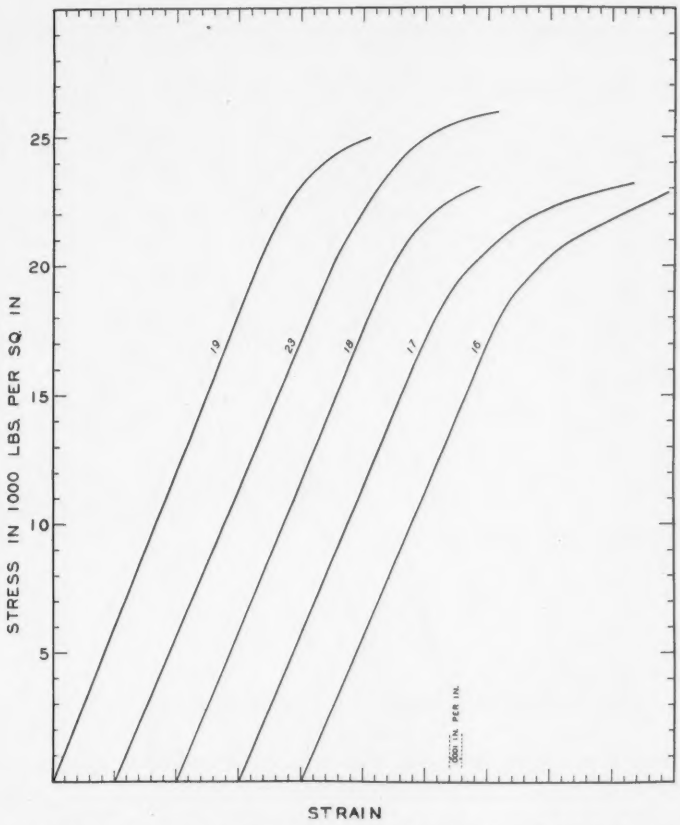

Fig. 6.—Average stress-strain diagrams for alloys Nos. 16, 17, 18, 19 and 23 in softened condition; trade named alloys whose Brinell numbers were between 76 and 100.

The presence of platinum metals in the alloys seemed associated with a decrease in the values noted for elongation. The other properties of the alloys seemed little affected by the presence of these metals.

It is to be remembered in this connection that the alloys tested were all much softer and of lower strength than the high platinum alloys used for clasps and bars and that the foregoing observation should not be applied to the harder alloys.

Average stress-strain diagrams for the trade alloys studied are shown in Figures 4-8. Figure 9 gives similar curves for 22-carat light, 22-carat dark and coin golds. These diagrams show the changes in properties of the golds ranging from alloy No. 1, which contains no base metals and which has low tensile strength and a more or less indeterminate elastic limit, to the harder golds whose elastic limit and ultimate strength values are very large in comparison with those of the high carat golds. The modulus of elasticity of each of the alloys studied was calculated. The values for this property were between 11,000,000 and 12,500,000 pounds per square inch with two exceptions in those golds whose Brinell

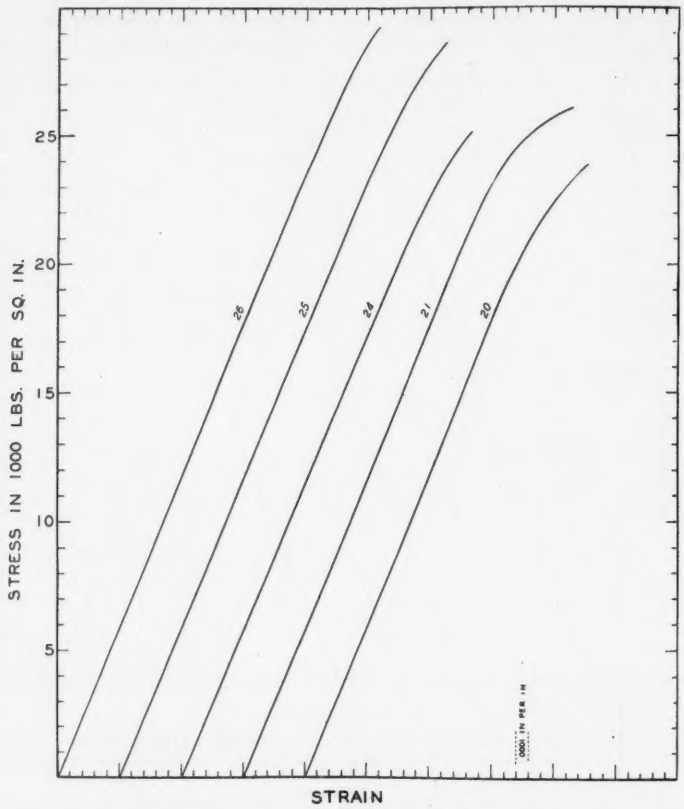

Fig. 7.—Average stress-strain diagrams for alloys Nos. 20, 21, 24, 25 and 26 in softened condition; trade named alloys whose Brinell numbers were between 76 and 100.

hardness numbers were over 50. The values for the soft golds (Brinell numbers below 50) were between 7,000,000 and 10,000,000 pounds per square inch.

Figure 8 shows the effect of the hardening treatment (reheating the quenched alloys to 450 C. [842 F.] followed by cooling to 250 C. [482 F.] in thirty minutes) on the tensile properties of four of the alloys. The effect of the hardening was not very marked except in the case of alloy No. 28. The softer alloys were little affected by the hardening treatment; and, in the case of the very high carat golds, some additional softening resulted from the treatment.

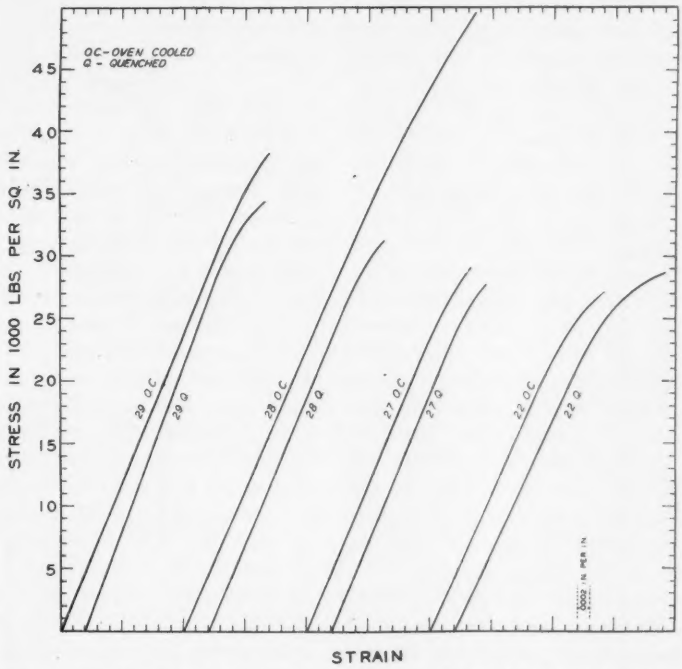

Fig. 8.—Average stress-strain diagrams of alloys Nos. 22, 27, 28 and 29 in softened condition (Q) and in oven cooled or hardened condition (O.C.)

The fusion temperatures as determined by the wire method increase with the proportions of precious metals present in the alloys. Copper, when present, has a marked effect in lowering fusion temperatures, while the platinum group metals tend to give higher fusing alloys. The recorded values for this test fall within the fusion range determined on much larger samples and, as far as the inlay casting golds are concerned, give data of practically as great value without the necessity of using large samples and without requiring long periods of time to complete the test.

COMMENT

The alloys studied may be classified

into four groups on the basis of the hardness numbers:

Very Soft Inlay Golds.—The alloys having hardness numbers below 40 may be considered as very soft inlay golds. This group includes the 24 and 23 carat golds of the type which were for the most part popular when the inlay casting process was first developed. These alloys contain little base metal and are very difficult to cast free from blow holes and occluded gases.

This group have low strengths and elastic limits, and while the elongation as measured was not extremely high, the materials are so soft and ductile that castings may be swaged and margins burnished easily. The older types of cast inlay technics required a material of this type because the technics themselves and

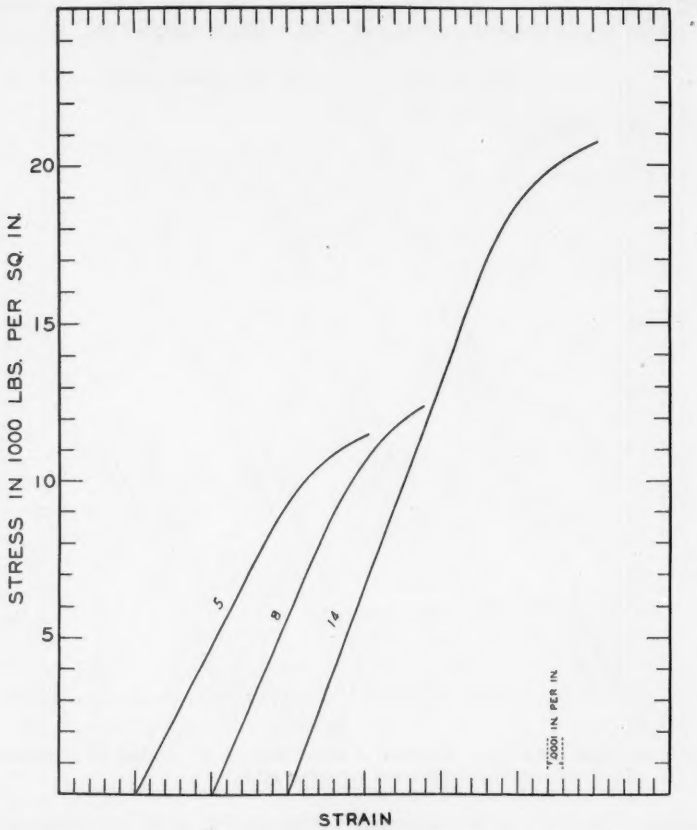

Fig. 9.—Average stress-strain diagrams for alloys Nos. 5, 8 and 14 in softened condition; 22 carat light, 22 carat dark and coin golds, respectively.

the material used were so faulty that it was necessary to make large adjustments in the cast inlay. The properties of the alloys of this group enabled workers to make apparent fits of castings which would be considered unsatisfactory in view of the present methods of making cast inlays.

While the margins of a casting made of this type of alloy can be easily burnished down to the tooth structure, the resulting thin film of metal at the margin has very little strength.

Such margins are very easily distorted and are liable to be pulled off in the burnishing process, and the underlying cement is liable to be thus exposed. The same result may be expected in using dental floss or toothpicks if they catch on any slight projections. It appears that with the improvement in methods of casting, certain phases of the usefulness of these alloys have been eliminated. The next harder group of alloys are very ductile and at the same time have much higher strengths and elastic limits. Margins of this second type of alloy are much less liable to distortion than are those of the very soft alloys. The authors believe that there is little real need for casting golds with hardness numbers below 40. There are many members of the dental profession who have consistently advocated the use of these softer alloys, but when consideration is given to the fact that a well made hammered foil filling has a hardness number of 50 or over and that this is usually considered about as soft a material as can be used with lasting results, it would seem that cast inlays should be made of alloys of greater hardness numbers than 40.

Soft Inlay Golds.—The second type of alloys range in hardness from Brinell number 40 to Brinell number 75. As the combined gold and platinum contents range from 83 to 92 per cent by weight, the alloys in this group are from 20 to 22 carat.

The hardness range given is a rather wide one, and there is a correspondingly wide range in strength and elastic limit values, but the values for elongation are relatively high for the entire group.

The high elongation values, which serve as a relative measure of ductility, indicate that margins of castings made from these alloys may be burnished to place. The higher values for elastic limit indicate that more pressure will need be applied to carry this procedure out properly, but, at the same time, the margins when finished will be strong enough to meet most service conditions.

These increased strength, hardness and elastic limit values, accompanied by high elongations, indicate that these alloys are mechanically the proper type for the simpler types of cast inlays, particularly those where the stresses to be encountered are low. The softer members of the group are best suited to the production of small class 1, 3 and 5 inlays, cavities grouped according to the classification of G. V. Black.[5] The harder materials in the group may serve for the production of class 2 and class 4 inlays where the stress is not large or where the bulk of metal used is great enough to carry the probable load. These alloys do not have sufficient strength and hardness to make them generally serviceable for three-quarter crowns or bridge abutments and the next harder group of alloys should be used for this purpose.

The usual policy of manufacturers and dentists in using the terms "hard" and "soft" in describing alloys without any

5. Black, G. V.: Operative Dentistry, Vol. 1, p. 203.

fixed basis for reference has led to much confusion. Alloys in the group under consideration were called both "hard" and "soft" by the different manufacturers. This situation could be much improved if the manufacturers of inlay golds would give the properties of their products so that the dentist could have a logical means of selecting an alloy for a particular use.

Medium Inlay Golds.—Alloys with Brinell numbers from 70 to 100 may be considered as "medium inlay golds." These alloys are harder and stronger than the preceding groups, but the elongation decreases considerably. They are so strong that it is difficult to burnish margins to place, and it becomes necessary to make castings accurately to the size of the cavity since the ductility of such golds cannot be utilized to cover an appreciable cement line.

Mechanically, these golds have sufficient strength for all types of inlay preparations and for all three-quarter crowns except those which must of necessity be of thin section and which must at the same time resist heavy stresses. The large majority of the popular three-quarter crown golds fall in the upper hardness range in this group. The low hardness range contained very few of the alloys tested, while two popular alloys for general inlay work were found to have a hardness of 85.

There has for years been a considerable amount of discussion of the types of alloys which should be used in the mouth. The arguments and discussions have included condemnation of hard alloys as the source of traumatic occlusion through their failure to wear at the same rate as the teeth although the relation between wear resistance and hardness is not very well understood. Soft golds have been classed as unsatisfactory because of frail margins, distortion under pressure and excessive wear.

This intermediate group of alloys seems to be a very popular one with the dental profession, and they may be considered as affording a happy medium between the very hard and the very soft alloys. We are not prepared to discuss or defend arguments for the possible physiologic results (possible causes of trauma, etc.) of the use of any group of alloys, and this report has only to do with the mechanical properties of the various types of alloys. It is hoped that it may assist the members of the dental profession in the selection of the proper materials for a particular use through the discussion of these mechanical properties. The dental profession must make its own decision as to the proper types of alloys for use after it has received data on and has become familiar with the physical and mechanical properties of dental gold alloys.

Hard Inlay Golds.—There are certain dental uses for cast golds which require high strength. Thin three-quarter crown castings are often made to conserve tooth structure and, as bridge abutments, these are often called on to support heavy stresses. Alloys which are harder than the preceding group and which may be called "hard inlay" golds are suitable for these purposes. Alloys with hardness numbers from 100 to 125 are commonly recommended for these uses. The increased hardness is accompanied by increased elastic limit and ultimate strength, while the elongation is still further decreased. These alloys can be polished, but it is practically impossible to burnish them when they are in position in the mouth. Castings of this type should be made with great care and

by exact technics, technics which will produce castings that will fill the cavities accurately.

Alloys of this type were found to contain 80 per cent or more of gold and platinum metals. The fusion ranges were higher than that which would lend itself to the practical production of large one-piece or denture castings. It was found that the tensile properties of this type of alloy could be considerably improved by a hardening treatment, but the elongation value decreased sharply with this treatment. The usual description of this effect would be to say that the alloy becomes very brittle.

A consideration of the general characteristics of all types of alloys after the hardening treatment was applied showed that, in general, it is not advisable to attempt to harden inlay castings by heat treatment. This type of treatment resulted in greatly decreased elongation in proportion to the improvement of other properties, and it seems evident that if increased hardness, elastic limit or strength is desirable, it may best be obtained by using a harder alloy having the desired characteristics in the softened condition.

CONCLUSIONS

1. "Gold color" gold alloys for making cast inlays should be divided into three types. The physical properties of these three types will be expressed in tabulated form as a part of a specification for inlay golds.

2. Cast inlay golds should be used in the softened condition to obtain the best elongation values.

3. Hardness numbers of softened inlay golds bear such direct relationship to other properties that this property serves better than any other one property to define the characteristics of alloys of these types.

4. The elongation of an alloy in tension is an important property as it indicates the ease with which an alloy may be burnished, its toughness and its resistance to shock.

5. The hardness number combined with the percentage of elongation will serve to define the characteristics of a cast inlay gold for most practical purposes.

6. Chemical composition of an alloy is important only as far as it serves to indicate color, resistance to corrosion and tarnish. Physical and mechanical suitability for a particular use is more important than gold or platinum content.

These conclusions were summarized in a tentative specification for inlay casting golds (gold color), which was referred to manufacturers of dental alloys for suggestion and comment. There was considerable discussion of the various details, and the director of the Bureau of Standards called a conference to discuss them at length.

This conference was held at the Bureau of Standards, March 30, 1931, with about thirty representatives of manufacturers, government departments and the American Dental Association present.

The details of the specification as originally drawn were discussed at length. Various changes in the specification were proposed to simplify test work for compliance with the requirements, to clarify the method of expression or to bring the specification into agreement with the prevailing dental and manufacturing practice.

After the conference, the specifications were revised in several minor details and transmitted to the Research Commission of the American Dental Association as a standard recommended for approval by the Association. The specification is given in full below.

AMERICAN DENTAL ASSOCIATION SPECIFICATION NO. 5:

TENTATIVE SPECIFICATION

FOR

DENTAL INLAY CASTING GOLDS (GOLD COLOR)
(APPROVED OCT. 19-23, 1931)

I. Alloys for cast inlays shall be divided into three groups as follows: A, soft; B, medium, and C, hard.

II. General Requirements: 1. Color. The color of the gold shall be the color specified by the purchaser. 2. Casting. The molten gold shall fill the mold completely when cast into dental casting investment. 3. Physical properties. Physical properties of the gold with the exception of fusion temperature shall be determined on castings quenched from 1290 F.

III. Detail Requirements: The detail requirements are given in the accompanying table.

IV. Methods of Inspection and Test: 1. Composition. The determined values for metallic constituents shall be recorded as the nearest 0.5 per cent. When a determined value falls midway between a half and a whole number, the whole number shall be recorded.

2. Physical properties. Physical properties other than fusion temperatures shall be determined on cast samples placed in a furnace at 1290 F. for ten minutes and quenched in water at room temperature. Cast samples shall be prepared by casting into a dental casting investment which complies with American Dental Association Specification No. 2 by any dental casting method. The use of a wax pattern is not required.

An alloy complies with this specification when all of the recorded values for the properties of three or more of a series of six castings meet the requirements. The recorded value for each property shall be obtained by averaging the determined values for all samples meeting the requirements of the specification.

3. Brinell number. The Brinell number shall be determined by applying a load of 27.8 pounds (12.6 kg.) on the sample through a one-sixteenth inch hardened steel ball for thirty seconds. The diameter of the depression shall be determined by measuring two diameters perpendicular to each other and the average diameter used in the calculation of the hardness number. The determined value shall be recorded as the nearest whole number. When the determined number falls midway between two numbers, the even number shall be recorded.

4. Yield point. A. The yield point shall be determined on cast samples whose diameters are between 0.070 inch and 0.090 inch. The gage length used shall not be less than 2 inches. An averaging strain gage shall be used. B. An initial load calculated to produce a stress of 5,000 pounds per square inch shall be applied to the sample and the strain gage read. The load shall then be increased to the minimum values for the yield point (Type B, 22,000 pounds per square inch; Type C, 27,000 pounds per square inch), and a second reading taken. The maximum strain permitted between the limits specified is: Type B, 0.0017 inch per inch; Type C, 0.0020 inch per inch. The determined value for strain shall be recorded to the nearest 0.0001 inch per inch. When the determined strain falls midway between two numbers, the nearest even number shall be recorded. C. As an alternate method, loads above and below the two limits specified may be applied provided they do not vary the stress over 500 pounds per square inch from the specified loads. The recorded strain may be determined graphically.

5. Elongation. A. Elongation shall be determined on the samples used in the test for yield point. The load shall be applied slowly and continuously after the strain gage is removed until rupture occurs. Castings which break outside the gage marks may be repulled. Elongation shall be measured on a 2-inch gage length. The determined value shall be recorded as the nearest 0.5 per cent. When the determined value falls midway between a half and a whole number, the whole number shall be recorded. B. If deductions are to be made for the presence of platinum group metals, the manufacturer shall either (1) state a minimum guaranteed platinum metals content on the package or (2) guarantee on the package that the alloy contains 1 per cent or more of platinum group metals for each 0.5 per cent that the elongation falls below 12 per cent.

6. Fusion temperature, wire method. The fusion temperature is the temperature at which a wire 0.028 to 0.032 inch in diameter and approximately one-sixteenth inch long, supported at both ends, will break when subjected to a cross bending load of 3 ounces avoirdupois. The heating rate within 100 F. of the breaking point shall be between 10 and 50 F. per minute.

V. Packing: 1. The minimum net weight of

the contents shall be marked on each package. 2. Each package shall be marked with a serial number or combination of letters and numbers which shall refer to the manufacturer's records for the particular lot or batch of alloy.

VI. Notes: 1. Types. The requirements given cover only those types of golds primarily used for inlays. Requirements for harder casting golds and for wrought alloys are in process of development.

2. Uses. The usual uses for the three types of alloys specified are: Type A, soft inlays, easily burnished and subject to very slight stress; Type B, inlays subject to moderate stress, three-quarter crowns, abutments, pontics, full crowns and sometimes soft saddles; Type C, inlays subject to high stress, thin three-quarter crowns, thin cast backings, abutments, pontics, full crowns and saddles.

3. Hardness number. The use of a 13.9 pound (6.3 kg.) load for the determination of hardness numbers below 50 is permissible.

4. Guarantee. Manufacturers may indicate that their products comply with these requirements by (a) a statement on the package guaranteeing the material contained therein to meet the requirements of this specification or (b) a statement of the chemical and physical properties of the material in such detail as to cover all the requirements specified.

5. Responsibility for any guarantee. All statements or guarantees that products meet this specification are made by manufacturers on their own responsibility. In the event of disagreement between purchaser and manufacturer, the American Dental Association will act in an advisory capacity and will designate testing laboratories having equipment for making tests of dental golds.

The data indicate that the alloys tested meet the foregoing requirements for inlay golds as follows: Type A, soft, Nos. 4, 6, 7, 9, 10, 11, 13 and 15; Type B, medium, Nos. 15, 18, 19, 20, 21, 22, 24, 25 and 26; Type C, hard, Nos. 20, 21, 24, 25, 26, 27, 28 and 29.

There are several golds which are classified as meeting the requirements of both Type B and Type C. Their properties are such that they form the hardest group in Type B and the softest group in Type C.

Some of the preceding reports on the properties of dental materials have carried either the names of all the products tested or of those materials found to meet specifications for various types of dental materials. The trade names of the gold alloys tested have not been given in this report. Several manufacturers plan on making changes in the formulas of the trade named alloys tested to cause them to fall definitely into one of the three specified groups. Others plan new alloys to meet the requirements. It was felt that an injustice would be done to these manufacturers if the trade named products were rated against a specification before an opportunity was afforded for necessary changes in formulas and properties to comply with it.

It is certain that alloys of known physical properties and guaranteed by the manufacturers to meet the requirements of the specification will be available soon after the publication of this report. The dental profession may select alloys for particular uses from these guaranteed products with the assurance that the alloys may be cast consistently to produce satisfactory dental restorations by any fundamentally sound casting technic.

MERCURY FOR DENTAL AMALGAMS*

By AARON ISAACS†, Washington, D. C.

SEVERAL years ago, a study[1] was made of the properties of dental amalgams by the Bureau of Standards. Subsequently, a study was made by the American Dental Association, and a specification was adopted by the Federal Specifications Board and the Association for amalgam alloys. Up to the present time, no specification has been adopted for the mercury used with these alloys to make the amalgam. The purpose of this work was to compare the quality of the various grades and brands of mercury available to the dental profession and to develop a specification for mercury satisfactory for use in the making of dental amalgams.

TEST FOR BASE METAL IMPURITIES

In order to develop tests for the probable impurities in mercury, it was necessary to make up samples of mercury containing definite amounts of the impurity for which the test was being made. The mercury used for this work had been carefully purified at the Bureau of Standards. To separate samples of this mercury, 0.001 per cent each of copper, zinc, tin, lead, bismuth, cadmium, arsenic, antimony, silver and gold were added. This was done by weighing out the metal to be added and dissolving it in the necessary amount of mercury. Solution was effected at room temperature in most instances. The mercury to which was added silver and gold was warmed to 80 C. and that containing antimony was heated to 150 C. to effect solution. It is doubtful that any arsenic was taken into solution by the mercury. The arsenic was heated with the mercury for prolonged periods at various temperatures up to 200 C., but little, if any, arsenic seemed to go into solution even at the highest temperature. If any arsenic did go into solution, it was only a small fraction of the 0.001 per cent originally added. The chemical properties of arsenic and antimony are so similar that even if arsenic could have been introduced into the mercury in some other manner, its presence would undoubtedly have been revealed in the same way as was that of antimony and the other base metals, as described in the next paragraph.

The presence of each of the metals added, except silver and gold, was at once indicated by the changed appearance of the mercury. The mercury lost its characteristic appearance and a film or "skin" formed on the surface, or the metal wetted the glass container and the container could not be completely emptied of it. The effect was very pronounced

*Publication approved by the director of the Bureau of Standards.

*Read before the Section on Partial Denture Prosthesis at the Seventy-Third Annual Session of the American Dental Association, Memphis, Tenn., Oct. 21, 1931.

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1. Souder, Wilmer, and Peters, Chauncey: Physical Properties of Dental Materials, Tech. Paper Bur. Standards 157; Dent. Cosmos, 62: 305 (March) 1920. Taylor, N. O.: Specification for Dental Amalgam Alloys, J.A.D.A. 17:112 (Jan.) 1930.

and could be readily detected in every case. (Because of the surprising nature of this observation, the tests reported were repeated by H. J. Wing, working independently. His observations confirmed those reported here.) Probably even smaller amounts of base metal could have been detected by this procedure, but amounts of base metal less than 0.001 per cent would in themselves be of no significance to the dentist. This extremely simple test, therefore, may be used as a limiting test for all base metal impurities.

PURITY OF SAMPLES OF COMMERCIAL MERCURY

Sample	Grade	Source	Container	Base Metal Impurities Per Cent	Non-Volatile Residue* Per Cent
1	U.S.P.	Mallinckrodt Chem. Works	Glass	Less than 0.001	0
2	U.S.P.	Merck & Co.	Glass	Less than 0.001	0
3	U.S.P.	Jobber 1	Glass	Less than 0.001	0
4	U.S.P.	Jobber 2	Stoneware	Less than 0.001	0
5	U.S.P.	Local Drug Store	Glass	Less than 0.001	0
6	Dental C.P.	J. M. Ney Co.	Glass	Less than 0.001	0.002
7	Dental C.P.	S. S. White Dental Mfg. Co.	Glass	Less than 0.001	0.001
8	Dental C.P.	L. D. Caulk Co.	Wood	Less than 0.001	0
8a	Dental C.P.	L. D. Caulk Co.	Glass	Less than 0.001	0
9	Dental C.P.	Research Prod. Co.	Glass	Less than 0.001	0
10	Dental C.P.	Goldsmith Smelt. & Ref. Co.	Wood	Less than 0.001	0
11	Dental C.P.	Garhart Dent. Spec. Co.	Glass	Less than 0.001	0.001
12	Dental C.P.	Thos. J. Dee & Co.	Glass	Less than 0.001	0.007

*The nonvolatile constituent in all cases was silver.

TEST FOR SILVER AND GOLD

The effect of the presence of silver and gold in mercury was much less marked than that of base metals. Amounts of silver and gold up to 0.1 per cent could not be detected by any change in the appearance of the mercury.

For the detection and estimation of silver and gold in mercury, the nonvolatile residue from the mercury was determined. Base metal impurities did not interfere with this test as their absence in amounts that would interfere was indicated by the previous test. For the nonvolatile determination, a sample weighing about 15 gm. was placed in a weighed porcelain crucible and the mercury volatilized at a temperature of about 200 C. Much of the mercury condensed on the walls of the crucible, and this was driven off by heating the crucible to a higher temperature. Finally, the crucible was heated to a dull red to drive off any mercuric oxid that might have been formed during volatilization, and was cooled in a desiccator and reweighed. The method was found to be accurate both for the detection and for the determination of silver and gold. Separate solutions containing 0.001 and 0.01 per cent of silver and gold in mercury were made up, and when each of the four solutions was volatilized by the foregoing procedure, the added metals were quantitatively re-

covered. (The results of the foregoing tests indicate that the ordinary mercury of commerce is a much purer product than is generally recognized. Such mercury generally has a fairly clean surface and, hence, cannot contain more than minute amounts of base metal impurities.)

EXAMINATION OF COMMERCIAL SAMPLES OF MERCURY

For the purpose of making a comparison of the various grades and brands of mercury available to the dental profession, thirteen lots were purchased in the open market. Of these, eight were well known brands of "chemically pure" mercury supplied by manufacturers of dental alloys for use in dentistry. The other five samples were purchased as U. S. P. mercury. Two of these were products of well known manufacturers of chemicals and pharmaceuticals, two were obtained from jobbers in chemicals and pharmaceuticals and one sample was purchased from a local drug store.

The two tests for purity employed were described above. The "appearance test" was used for the estimation of base metal impurities and, in the absence of these, the nonvolatile residue was determined for the estimation of silver and gold.

In reviewing the results of the tests, it may be said that all the samples of mercury examined were of satisfactory purity for use in dental amalgams. The appearance of four of the samples was not entirely satisfactory. Mercury from these samples, when filtered through a pinhole, had a satisfactory appearance in all cases. It must be noted that while base metal impurities will always be indicated by an unsatisfactory appearance of the mercury surface, contamination of the mercury is not necessarily an indication of the presence of base metal. Contamination may also be caused by dust, grease or almost any kind of foreign matter from the air or from unclean containers. In all four instances mentioned above, the trouble probably was caused by the type of container. In one case, the mercury was received in a stoneware jar; in another, the cap closing the container had a paraffined cork stopper that came in contact with the mercury and may have caused the contamination, and in the other two instances, the mercury was received in wooden containers. Both stoneware and wooden containers are inferior to glass for bottling mercury of high purity. Both types of containers are hard to clean, and it is impossible to tell when they are clean. It is very difficult to get even glass containers scrupulously clean. They should be scrubbed, thoroughly washed and dried by baking. Cork stoppers should preferably be protected by parchment paper or some similar means.

STANDARDS OF PURITY

Many different terms, such as "pure," "chemically pure," "distilled," "redistilled," "double distilled" and "U.S.P" are used to designate the quality of mercury. None of these terms has a definite meaning except the term U.S.P., which means, of course, that the mercury must conform to the specification given in the U. S. Pharmacopeia. Even the term "chemically pure," whether used in connection with mercury or with other chemicals is not defined either by legal or by generally accepted standards, and, unfortunately, has lost any significance it may have had when originally introduced. Such terms as "distilled," "double distilled" and "redistilled" are without meaning as far as purity is concerned, because the degree of purification obtained by distillation

varies with the raw material and the methods of distillation.

The requirements given in the U. S. Pharmacopeia are entirely adequate for mercury to be used in dentistry. As a matter of fact, it would be sufficient to use only that part of the specification included under the heading "Tests for Purity"; that is, the requirements that the mercury shall have a clean bright surface even after agitation in contact with air, and that the nonvolatile residue shall not exceed 0.02 per cent. The further requirement of an assay of 99.5 per cent is misleading and without significance. This low limit for the assay probably was chosen to allow sufficient tolerance for the accuracy of the method of assay rather than because of the poor quality of mercury available.

PROPOSED SPECIFICATION

The following specification for dental mercury is suggested:

1. The mercury shall have a bright mirror-like surface free from any film or scum. Under certain conditions of storage, mercury may develop a slight film. Such mercury should readily be separated from this film by filtration through chamois skin or some similar filtering medium and, when filtered, should remain bright after agitation with air. It shall pour freely and in its entirety from a thoroughly clean glass container.

2. The mercury shall have a nonvolatile residue of not more than 0.02 per cent when the mercury is evaporated from a porcelain crucible at a temperature below its boiling point, and the crucible is then ignited at a dull red heat.

The proposed specification for purity was adopted as part of the American Dental Association's Specification No. 6, "Tentative Specification for Dental Mercury," Oct. 18, 1931. The following additional requirements are contained in the American Dental Association's Specification:

Methods of Inspection and Test: 1. The determination of nonvolatile residues shall be made on samples having a weight of from 10 to 15 gm.

Packing: 1. The minimum net weight of the contents shall be marked on each package. 2. Mercury shall be packed in clean clear glass containers.

Notes: 1. Guarantee. Manufacturers may indicate that their products comply with these requirements by placing a statement on the package guaranteeing the material contained therein to meet the requirements of this specification.

2. Responsibility for any guarantee. All statements or guarantees that products meet this specification are made by the manufacturers on their own responsibility. In the event of disagreement between purchaser and manufacturer, the American Dental Association will act in an advisory capacity and will designate testing laboratories having equipment for making necessary tests.

GOLD FOIL*

By CHARLES E. WOODBURY, D.D.S., Council Bluffs, Iowa

I AM not going to discuss today the respective merits of gold foil and the gold inlay, any more than I am going to discuss the relative merits of synthetic porcelain and amalgam. There is a place for all these filling materials, and I use them all in my practice. There are some of you who have discarded the use of gold foil entirely from your practice and with it the most admirable invention of Dr. Barnum, the rubber dam.

Those of us who have not discarded the use of gold foil realize that you who have done so have discarded one of the greatest methods of restoring lost tooth structure that has ever been brought before the dental profession. I would not for one moment deny the permanent and convenient qualities of the gold inlay, which has succeeded it, any more than I would deny the esthetic qualities of the silicate cement or the porcelain inlay.

There is a place among our dental procedures for the gold foil filling, and he who has abandoned its use is, in my judgment, failing to give his patients the best service of which he is capable. Gold foil is an exceedingly faithful servant to those who understand and appreciate its good qualities and recognize its deficiencies and limitations. To those who do not recognize these peculiarities, who have not had the patience to learn to overcome its deficiencies, it is an ever unfaithful servant.

A gold foil filling, where it is indicated, may be either the best filling that can be made or the poorest, according to the experience and teaching of the operator. A poor amalgam filling, synthetic filling or gold inlay will last at least three or four years, but a poor gold foil filling begins to leak the moment the rubber dam is taken off and it is submitted to moisture.

The oft-repeated cry that the patient will not stand the tedium of the long sitting that gold foil requires is, in my experience, not true, and I have had more experience with gold foil than most of you. I have been in active practice almost forty-five years. For twenty-five years, I have belonged to a study club which specializes in the manipulation of gold foil. I have been a teacher in a dental college for twenty-three years and have taught the branch of gold foil. In all that time, I have found very few patients who would not submit to any inconvenience that is necessary to produce a better operation.

If the statement had been that the operator would not submit himself to the task of making a gold foil restoration, I would say that that was true. I think the dentists of today are more and more looking for an easy thing. This is evidenced by the tremendous growth of the dental laboratories in the last twenty-five

*Read before the Section on Operative Dentistry, Materia Medica and Therapeutics at the Seventy-Third Annual Session of the American Dental Association, Memphis, Tenn., Oct. 21, 1931.

years. If we get dental insurance, contract dentistry or recognition of the laboratory technician, it is our own fault, and no one is to blame for it but ourselves.

The line of force is considered by nearly all gold foil operators to be the most essential thing in the making of a filling. A very good foil filling may be made in a very indifferently prepared cavity if the correct line of force is used. But no matter how excellent the cavity preparation, if an incorrect line of force is used, a leaky filling will result. It is rather difficult to obtain this line of force in those cavities in the occlusal surfaces of the molars where gold foil is so strongly indicated.

A leaky filling will often result in the mesial part of these fillings owing to the difficulty of getting the required line of force at this location. The shaft of the plugger controls this line of force and not the direction of the different bends in the plugger, which are only there as a convenience. The direction of the shaft of the plugger should be such that it shows an inclination against the particular wall to be approached. This requires that the operator shall not keep to one position at the chair, but shall operate with equal facility from the right side of the patient, behind the patient and to the left of the patient. If he is so fortunate as to be ambidextrous, this movement from one side of the chair to the other may be considerably restricted by standing behind the patient, using the right hand and the left hand alternately when operating on the lower molars.

The gold inlay has reached its greatest field of usefulness in the proximal surfaces of bicuspids and molars, where in excellence it approaches very closely the gold foil filling. But, in the proximal surfaces of the front teeth, and in pit and fissure cavities in the back teeth, the gold foil filling still stands unexcelled, and it is to these two classes of filling that I wish to call particular attention today.

The preparation for pit and fissure cavities in the bicuspids and molars should be as narrow as the extent of the caries will allow. These pit and fissure cavities, which we often find soon after the teeth have erupted, are due to the failure of the various islands of calcification to thoroughly coalesce. If filled early, these cavities will not necessarily have to extend to the dentino-enamel junction except in the central pit, and need not be opened wider than the width of a 700 fissure bur, which is about 0.7 mm. As time goes on, unless these fillings have been promptly made, decay progresses very rapidly along the dentino-enamel junction and the extent of the cavity necessarily becomes greater and greater.

It is not always necessary to cut away all of the enamel that is not supported by dentin. This enamel on the occlusal surface of the molars is from 1.5 to 2 mm. thick, and if enough is cut away so that all of the decay can be taken out at the dentino-enamel junction, these undercuts can then be filled with a heavy mix of cement and the enamel retained permanently. Enough enamel should always be cut away so that the operator can be sure that all of the decay is removed from the dentino-enamel junction. Otherwise, the presence of the resilient mass of decay will cause the eventual breaking of the enamel and loss of the filling. No undercuts are needed in these cavities for the retention of foil. If the cavities are small, they are opened only to the dentino-enamel junction at the central pit. From this pit, the enamel is beveled as far as the extent of the cavity demands. If the cavities are larger, Black's familiar cavity with the flat pulpal wall and the

axial walls arising from it, which must be parallel to each other at least in two places, is used.

If the cavities are too large, an inlay is often indicated. But it is not these large cavities that we are going to talk about today, but the smaller ones. These fissures, which are halfway or more through the enamel, should be cut out, and if the patient is old enough, a permanent repair made. By doing this, we may be anticipating decay; but when the decay gets through the enamel to the dentin, it progresses so rapidly that we are more than justified in anticipating it. When these fissures are examined, they should be thoroughly cleaned, washed with hydrogen peroxid, dried and carefully examined with a fine pointed explorer and a pair of binoculars. You will be surprised to learn how many of them extend more than halfway through the enamel. The filling of them, if the line of force is correct, is a comparatively simple matter.

Pluggers as simple in design as is possible should be used; for most cases, the contra-angled parallelograms being all that is desired. In very small mouths or for lower molars that are very badly inclined toward the lingual aspect, often the long bayonets must be used to get the desired line of force. The line of stepping in all five-wall cavities is always from the center of the cavity toward the periphery.

Gold foil fillings can be made in the front teeth, if the cavities are not too large, with little exposure of the gold. If the lines of the filling harmonize with the lines of the tooth, it is astonishing how these fillings blend in the tooth if the lines of the cavity are correctly made and the anatomic structure of the tooth is faithfully restored.

The fillings are made by first filling the gingival retention with a line of force nearly at right angles to the axial wall but inclined slightly toward the gingival. The line of stepping in these cavities, like those in the occlusal surface, is from the center toward the periphery, the main thing being to build the gold on the axial wall instead of on the gingival wall. This procedure, which is followed out practically through the whole filling, makes this filling either a very easy or a very difficult one, this depending on how faithfully the technic is followed out. If the lingual wall is covered very early in the operation and is kept fuller than the axial wall, and if the line of force is at right angles to the long axis of the tooth, there should be no difficulty in making this filling. The chair positions that make it easy to maintain these lines of force indefinitely were determined by placing the plugger in position to deliver the desired line of force and then taking such a position with the body that the hand and arm were comfortable.

DISCUSSION

George H. Mengel, El Paso, Texas: This paper should be an impetus to the members of our profession to again become interested in the technic of inserting gold foil fillings. It would be an outstanding accomplishment if the state dental societies would arrange to have men like Drs. Woodbury, Prime and Baird of Los Angeles teach the insertion of gold foil fillings until every member interested was proficient in the technic. After practicing thirty-two years, it is gratifying to me to see foil fillings that have been inserted ten, fifteen, twenty, twenty-five or more years still rendering a good service. I have seen occlusal foil fillings that were inserted forty years ago and are still in good condition. I have had Class III gold foil fillings in my left upper lateral and central incisors over forty years. The right central distal Class III filling was inserted by a University of Michigan student in 1897 or 1898; also a lower left second molar contains a foil filling inserted in 1899. We should again renew our enthusiasm

in the insertion of gold fillings and not be guilty of neglecting to render this very valuable health service to our patients.

G. W. Wilson, Milwaukee, Wis.: This paper has dealt largely with the technic of placing foil fillings. It has been presented in such a manner that even the most apprehensive must have been attracted by the simplicity, thoroughness and practical usefulness of gold foil. There are four phases of this paper which I should like to discuss. 1. Dr. Woodbury does not discuss the relative merits of gold foil, the inlay, silicate cements or amalgam, because he recognizes that each material has its place in practice. This, I think, is the rational point of view. It is a premise which many of us have failed to establish and this has resulted in the abandonment of foil from the practice of too many of us. It is interesting to observe that many of those who have cast foil out of their practice still hold that it is the filling par excellence in certain definite locations. Many of these men maintain that they do not use it because of their deficiency in the particular operative skill which is required to place a satisfactory filling. If this view is held earnestly, it is the duty of those operators to apply the same degree of study and effort to the mastery of a gold foil technic that they have applied to other operative procedures, and thus to acquire the necessary skill. Dental schools can do much to encourage the return of foil to its deserved position in practice by the teaching of a rational doctrine. The possibilities of foil fillings as preventive and restorative should be presented to the young men who are to be the dentists of tomorrow. Practice obtained by the use of this material is of great value in the development of finger dexterity. 2. Dr. Woodbury points to the particular classes of cavities in which foil should be used and in which, undoubtedly, no other material can be used to similar advantage. He mentioned the simple pit and fissure, both real and potential, which occur particularly in bicuspids and molars, and the simple proximal filling in the incisors and cuspids. To these two classes, I believe we should add a third, gingival third or cervical cavities. The use of silicate cement in this location is generally a failure, and the use of the inlay in these cavities, which are generally small, especially in the anterior teeth, is impractical and is destructive of tooth structure. 3. The statement by some that the patient will not tolerate the discomforts of a foil operation is largely imaginary. It is but logical to conclude that patients generally would choose that service which will be most certain to maintain oral health and efficiency. When the value of foil in cavities in which it is indicated is thoroughly explained, few will object to either the operative discomforts or the esthetic results from the use of this filling material. Confidence in the desirability of using foil must be firmly established in the mind of the operator. 4. The accusation that many dentists of today are seeking the line of least resistance is justified, to the discredit of our profession. The placing of foil fillings requires a rather highly specialized skill. It is hard work, but satisfying. Much of the criticism for this attitude toward professional responsibility may be leveled at a false modern economic philosophy. If the dollar sign and the line of least resistance are to be our beacons, then what quality of health service may we expect in the future from the profession? Let him who has a desire to render a more complete and better service to his patients recognize the fact that gold foil as a filling material by universal opinion occupies the highest position as regards permanency, efficiency and economy in three classes of cavities. Let him then apply himself and master the technic as presented here today by Dr. Woodbury, and treat himself to a sense of satisfaction and joy in the process.

DENTAL CARIES

By A. G. SCHNACK, A.M., M.D., Honolulu, T. H.

WE ARE still far from a solution of the etiologic problems that have arisen in the study of dental caries. There are a considerable number of investigators who are individually convinced that the etiology of caries is settled, but the viewpoints are as different as night is from day. It may be stated here that while much of the work done may in some way or other be eventually assembled into a common truth, we have as yet not produced much evidence that may be considered in the light of actual proof. Some of us have perhaps not had the opportunity to splash about a laboratory deducing opinions from test-tube findings, or to enter the field of experimental biology, but we can take the findings of the numerous investigators as published and perhaps pick out the "wheat from the chaff," which, combined with our personal ability to observe and compare dental and other body processes, may lead us to a proper viewpoint.

Our roentgenologic evidence and our gross and microscopic pathologic dental processes have a very wide range of interpretation, and one would perhaps be astonished to find how great this variance of opinion of the basic conditions is. In other words, a supposedly simple dental condition, such as caries, may mean one thing to one investigator and an entirely different thing to another. Unless we can start with a few uniform conceptions of what we are trying to prove, the problem of etiology must necessarily have an endless number of solutions.

A detailed description of the numerous theories offered will not be attempted, but some of the ideas presented will be briefly mentioned, and a few theories, perhaps deduced from comparisons with similar processes in other body tissues, may change the viewpoint of some of the investigators, and perhaps offer new tangents for investigative endeavor. No theory can be presented without the expectation of having it partially or completely refuted.

The study of caries involves consideration of a number of facts. The theory of lymph circulation through enamel, considered by some as established fact and by an equal number as nonexistent, has perhaps more evidence in substantiation than otherwise.[1] The finding of definite lymphatic channels in the enamel, arising from the dentino-enamel junction, in animals of a lower scale of development is important in these deductions. The staining of the enamel through dye injection of the pulp, etc., favors the idea of a lymphatic circulation through the enamel.

The organic matrix of the enamel may be in great part the means of diffusing substances through the enamel. That such a circulation should affect the mineral content of the enamel to some ex-

1. Beust, T. B.: Physiologic Changes in Structure of Enamel After Tooth Eruption, J. A. D. A., 11:396 (May) 1924.

tent under varying conditions must be expected. We might expect a diminished calcium content of the enamel under long continued conditions of diminished lime content of the blood.

In chronic interstitial nephritis with diminished blood calcium, we fail to note any special measurable dental effect. In osseous tissue, disuse produces a rapid absorption of lime, but the loss of lime from dental disuse is not a proven fact. That teeth actually harden with age is thought a definite fact in spite of probable diminishing use. Dehydration, physical and chemical internal rearrangement of molecules and the gradual deposit of secondary dentin may aid in the production of this apparent increase in density.

We all see the results of endocrine disturbances on tooth structure. Chronic disease, such as syphilis, and inherited tendencies, etc., may all produce defective dental structure. We might state that any "sick cell," or cell working in an unfavorable environment should not be expected to produce normal dental structure, and such defective structure should present points of less resistance to caries.

Vitamin deficiency experiments on animals may show most strikingly defective tooth development, which tends later to a readier development of caries and the production of an oral state (spongy gums, anemia, etc.) which of itself will tend to destroy even normal dental structures. Such conditions do not obtain in the consideration of ordinary caries.

It is assumed that a lymphatic flow takes place through the enamel by way of the dentinal tubules and enamel lamellae, and that this lymph flow originates from the pulp lymphatics. It is apparent that most of the lymph flow through the enamel must come from the pulp lymphatics, although it is well established that the alveolar socket communicates by fine fibrillary connections with the cementum (Sharpy's fibers), and thus a circulation in the enamel is possibly established through the marginal plexus.[2] This supply of lymph must of necessity be very small and can hardly contribute much to the nourishment of enamel or to changes in the enamel after dental eruption. In other words, we must insist on a functioning pulp for any appreciable lymph flow through the enamel structures.

That minor changes take place in the enamel structures through the pulp circulation in disease or with long continued variations in blood elements can easily be accepted. That these slight enamel changes in erupted teeth are responsible in great part for dental caries is a contention that does not rest on fact. It is my opinion that, should this contention be true, it would mean that an intact pulp would be necessary in all cases of caries. We have all seen teeth undergoing decay that have had root canal fillings for many years. Some of these teeth, through apical infection, may have lost much of their cementum attachment, and thus even this source of lymphatic flow is diminished or eliminated. These teeth may remain intact for a long time after restorative work has been completed, only suddenly to become carious.

One cannot consider that anything but an extra-dental oral influence causes decay in such cases, and this should pretty well establish the necessity for investigation of caries from this viewpoint. Re-

2. Orban, Balint: Dental Histology and Embryology, Philadelphia: P. Blakiston's Son & Co., 1929.

cent experiments[3] would indicate that caries does not necessarily progress rapidly in the absence of saliva, and this is taken as a proof that the diluting and cleansing action of saliva is not of importance in the prevention of caries.

Such a conclusion, in my estimation, should never have been deduced from these experiments. There is always an optimum range of dilution of fermentable food material to produce a maximum of acid fermentation. Complete absence of saliva or a local dilution which is only that of moist material should not produce the optimum fermentative conditions, especially when there is no amylase to reduce the starches to a more fermentable state. Stagnant saliva, we still think, offers the best environment for fermentation.

That there is a greatly diminished flow of saliva during sleep and during certain illnesses is apparent. The quantity of saliva secreted in an average day by an adult is estimated at in the neighborhood of 1,500 c.c. Some have pointed to drooling during sleep as evidence that saliva does not cease to flow. The amount secreted during sleep is negligible. The various salivary stimulants, which we shall not describe, practically all require the waking state for their effectiveness.

It should be definitely understood that dental caries is primarily a solution of lime salts through the action of acids. Such acids, although possibly regurgitated from the stomach, are thought to be produced in the mouth through fermentation (lactic and acetic acids) by the acid producing bacteria (acidophilus, etc.). Whether the enamel rods or the interprismatic substance is primarily attacked has no direct bearing on the problem.

It has been suggested[4] that perhaps altered blood conditions help to produce a saliva deficient in alkalis, and thus the diminished alkali reserve is quickly overcome by the acid fermentation, concentration of acid resulting which attacks the lime content of the teeth.

The argument presented above, namely, that a total absence of saliva does not induce caries, would tend to refute this statement. Such variations in the buffer action of saliva must be small under different conditions and would be difficult to demonstrate under the varying daily conditions, and with the changes occurring in the saliva after secretion. Assuming that a special oral state must exist for the development of caries, it must be a state conducive to the formation of acid.

It is my contention that the two necessary conditions are stagnation of oral fluid, allowing concentration for a considerable time, as in sleep, and, secondly, the establishment of acid-producing organisms, probably as a predominant type. It is hardly conceivable that much fermentation can occur on a pure meat diet; a fermentable carbohydrate is a first essential. Dilution of the acid during the waking hours, by food, water and other liquids, and by saliva, would hardly permit sufficient concentration to allow solution of enamel. Interproximal food plaques may, in many cases, carry fermentable substances capable of producing concentrated acid products that can destroy enamel. Experiments have been performed to show the harmlessness of candy, but these experiments do not show that the carbohydrates are given

3. Montgomery, M. F.: Effect on Teeth of Total Absence of Salivary Secretion, J. A. D. A., 17:1338 (July) 1930.

4. Jones, Martha R.; Larsen, N. P.; Pritchard, G. P.: Dental Disease in Hawaii, Dent. Cosmos, 72:439 (May), 574 (June) 1930.

just at bedtime, when we should expect the proper conditions for the concentration of acids by fermentation.

The nature of a carbohydrate is quite important from more than the fermentability aspect. We have a highly fermentable Hawaiian foodstuff, "poi," which has been credited with having marked anticaries properties from the fact that although it forms the chief constituent of the native Hawaiian diet, our native Hawaiians, as a rule, have very little caries.

Poi is very sticky when it touches anything dry, but in the mouth it is very cohesive and never clings to the mouth or teeth, leaving no oral residue. It is my contention that we must carefully consider fermentable foodstuffs from their tendency to invade and adhere to the tooth crevices or to the tongue surface, and that we need not think so much in terms of any special anticalcifying or vitamin agents. Mellanby[5] has attributed anticalcifying properties to certain cereals, but it is my conviction that the lack of cohesion in the mouth is more important.

That the character of the fermentable food is very important can perhaps best be shown by several examples.

In one case, a nurse, because of an ethmoiditis and optic neuritis of over a year's standing, had a set of dental roentgenograms taken. There was practically no evidence of caries. The patient was sent for a three months' vacation to a brisk climate for a rest. She rested considerably and felt greatly refreshed on her return. Because of a slight pain in a tooth, she had another set of roentgenograms taken. This time, eight dental cavities were revealed, several just about reaching the pulp chamber. The history was that the patient ate well, gained weight and attained a feeling of well-being, but over-indulged in candy, often taking a box of candy to bed at night.

Another example of changed diet that was not solved directly but was interesting was met when the German cruiser Emden touched at this port on a world cruise. At one dentist's office, about a dozen of the sailors sought dental care, all presenting the same story. Up to six months previously, at the beginning of the cruise, none of these men had had any evidence of dental caries, and several now had as many as four easily located cavities. (Roentgenograms were not taken.) The general condition of these young men was excellent, and they had actually improved physically in every case, but still had developed caries.

One can hardly conceive of defective dental structure manifesting itself so suddenly after twenty years or more.

The importance of establishing a predominating fermenting organism for the production of rapid caries is probably great. That this can easily be done is not apparent. The pabulum is probably determinative of just what organism will predominate to a great extent. We must not forget the rôle of salivary amylase (ptyalin) in changing starches into an easily fermentable state.

The rate of growth of different organisms is also important. A preponderance of fermentable carbohydrates favors the establishment of a predominating acid-producing organism. For example, we know that the fermentation diarrheas of infants are easily combated by a reduction of the carbohydrate elements of the food and an increase of the protein elements, the fermentative organisms thus being crowded out, through diminished nourishment, and the antagonistic putrefactive organisms favored. A liberal dose of lactose favors the establishment of *Bacillus acidophilus* and a pabulum rich in fermentable carbohydrates must be maintained.

It has been argued that the presence of tartar plaques on the teeth should be

5. Mellanby, May: Influence of Diet on Structure of Teeth, Physiol. Rev., 8:545 (Oct.) 1928.

conducive to the formation of caries. That one rarely finds caries in the immediate region of a tartar deposit is easily explained by the fact that these plaques containing glucoproteins, which are not fermentative, have much lime (phosphates and carbonates), which would necessarily offer resistance to the concentration of acid products and would have to be destroyed before the underlying enamel could be attacked. Many persons who do not brush the teeth will show such tartar deposits, which perhaps explain why the teeth are sound in spite of neglect.

Another statement advanced against stagnation as a factor in the formation of caries is that we often do not find caries in the presence of pyorrheal pockets. Alveoloclasia, or destruction of the alveolus, is in no way comparable to caries, which is merely solution of lime (in this case, enamel) by acid. Pyorrhea originating as a gingivitis results in an entirely different state. We need not have any acid accumulation in a pyorrheal pocket. Pyorrhea is the result of inflammation. Pus cells accumulate. The flow of the pus is outward into the buccal cavity, and it would be unusual, although possible, for food to remain over any great period in such a pocket. A small pocket forms under the gingiva, perhaps at first without absorption of the alveolar walls. Soon, pressure (which may be quite slight) develops locally and absorption of bone takes place, not through solution by acids but by the action of osteoclastic cells, an entirely different phenomenon.

Those who doubt that slight abnormal pressure can have such end-results, should recall the so-called "erosion" of the bony portions of the vertebral bodies by an aneurysm. Surely, the mechanical trauma here is not sufficient to produce such effects. We have merely a soft, intermittent but, what is more important, abnormal pressure applied in an unusual location, and the osteoclasts complete the work of destruction. The so-called apical abscesses of teeth also are apparently the result of bone absorption by tissure cells. Relieve the pressure in the abscess about the apex of the tooth, and we no longer have absorption but deposition of bone, even though it may take a long time to assume the normal appearance of the surrounding healthy bone, because of the irritation of the local infection, etc.

Pressure applied to a protruding abdomen will cause absorption of excess fat. Skull bones will be absorbed in the presence of tumors which do not invade the bone but exert a very slight local pressure. A pyorrheal pocket presents a condition of putrefaction and pus production rather than acid fermentation, and we should not look for caries.

We have a condition which, although present in other localities to some degree, is quite prevalent among our local children, especially the Japanese. Simonton and Jones have elected to call this condition "odontoclasia," and it is described as a rapid massive destruction of the enamel and dentin, generally of the deciduous teeth. Attempts to explain this phenomenon have been made on the basis of rickets and various other conditions. It is prevalent in Japan and the Orientals seem to be chiefly involved.

My experience shows that nothing abnormal can be seen in the enamel structure of these teeth before eruption as determined by the roentgen rays. Another fact that might be mentioned here is that the permanent teeth are generally well-developed and caries resisting. The Oriental seems to be more prone to the development of pyorrhea of a severe type early in life. The fact that, after wean-

ing, the child lives on the same diet as the mother, and that the mother's diet is the same during and after pregnancy, makes it difficult to determine just why we see such massive destruction of deciduous teeth, and apparently caries-resisting permanent teeth.

Should the condition of caries be blood-borne, we should expect to see the permanent set show evidence of deterioration. We must remember here that while the deciduous teeth are being destroyed, the patient is developing in most cases a perfect set of permanent teeth, which will remain intact. We find "odontoclasia" in wonderfully healthy looking children as well as in the undernourished.

We must look for the source of caries in an altered oral state. As stated above, it is my opinion that we need not seek this factor in a variation in the chemical constituents of the blood, which may directly affect the teeth or produce an indirect effect by allowing the accumulation of destructive acid through a diminished salivary buffer potency. The fact that the "odontoclasia" may with fair certainty be arrested at any period, by certain alterations in the diet, should not argue for an altered condition of the blood. Our "poi" diet has apparently a good effect when it is substituted for other food. It is not a high mineral-containing food, and it has a high starch content, but it also has the valuable quality of cohesion in the mouth, not leaving an oral residue.

Vitamins cannot reasonably be considered important here. Saliva as secreted varies between a 5.5. and 7 p_H and of itself should not have any dissolving action on enamel, a p_H of 5.5 being the equivalent of one five hundred thousandth gram of normal hydrochloric acid containing one five millionth gram of hydrogen in 100 c.c. of fluid. This naturally is not sufficiently acid to have any direct lime-dissolving action under ordinary conditions. The loss of available buffer in reducing saliva to this acidity might, of course, be important. It is hardly probable that variations in food can directly affect the hydrogen-ion content of saliva and be directly responsible for caries.

Our Japanese have an almost universal habit of pampering babies with sweets. To give the baby sugar tied in a cloth to suck is considered the very best way to induce sleep. This is dispensed with after a few years. It is surprising how widespread this procedure is among the Japanese. We have here all the ideal conditions for the production of acid mouth—sleep with its accompanying stagnation of saliva containing fermentable carbohydrates and ideal temperature and moisture conditions for the establishment of acid-producing organisms as a predominant type. Deciduous teeth are not structurally so nearly perfect as the permanent teeth, and this should also favor decay. Destruction of teeth under these circumstances is a most rapid process, the teeth barely erupting before they become eroded level with the gums in many cases. I cannot contend that every case of "odontoclasia" can be thus easily explained, as history-taking is most unsatisfactory with many of the parents.

Much has been written about the acid-base balance of the blood as a factor in caries. Some investigators would put all the emphasis on the effect of these blood variations on tooth structure during their development, insisting that later caries is merely a manifestation of poor development. Other investigators insist that the diet, with its resulting variation in blood elements, whether produced by vitamin deficiency, deficiency of ash-producing

foods, or the tendency to acid or base-producing qualities has an immediate direct effect on adult teeth. Our Oriental rice eater should theoretically from the acid reaction from his diet develop caries, but we find very little caries, and instead the antagonistic state of pyorrhea.

We have explained that a pulpless tooth has practically no circulation and may or may not become carious. Another point held by the many investigators is that the concentration of lime in enamel is very important in determining whether caries will or not develop. It is hard to see why a little variation in the lime content should make any difference. If the facts are analyzed, the organic elements of a tooth (enamel cuticle and stroma) are probably the caries resisting part of a tooth in the early stages of cavity formation, as lime itself (enamel) without its organic matrix would not last long. Caries does not develop on the mechanically eroding surfaces of enamel.

It may be that not enough attention has been given to the possibility that much of the rapid dental caries may be due to an acid regurgitation from the stomach. The "upset" stomach, with a foul breath and coated tongue, may represent a disturbance tending to an imperceptible regurgitation of gastric contents.

The frequency of massive third molar decay may be in great part due to faulty enamel structure, but its proximity to eructated gastric contents may be important. It would be interesting to note the infrequency of decay in its association with gastric anacidity, should this be a fact. Do certain foodstuffs in superabundance tend to produce gastric regurgitation? In illness or in certain nervous states, gastric atony and loss of sphincteric tone may similarly favor regurgitation of gastric juice.

CONCLUSION

Caries is in great part the result of the solution of enamel lime salts by acids in the mouth. Our findings regarding the pulpless tooth and other factors in the decay of teeth do not favor blood changes as the direct influence in the production of caries. Three possibilities exist as the fundamental causative agent in the development of dental caries: 1. A diminished "buffer" action of the saliva favoring the easy concentration of oral acid through bacterial fermentation. This diminished alkalinity may be the result of ingestion of certain foodstuffs, or of other conditions. 2. Imperceptible acid regurgitation from the stomach. 3. Acid fermentation in the mouth through the agency of acid-producing organisms, favored by highly fermentative adherent foodstuffs, with oral stagnation and concentration during sleeping hours, illness, etc. The proof of any of these theories would entail more painstaking endeavor.

ADDITIONAL NOTES ON ROOT AMPUTATION, INCLUDING A STUDY OF THIRTY-EIGHT NEW CASES*

By THEODOR BLUM, D.D.S., M.D., F.A.C.D., F.A.C.S., New York City

IN my experience, root amputation is one of the most successful conservative operations in the field of oral surgery from the point of view of esthetics, practicability and service. If one is radical in his opinions regarding pulpless teeth, a discussion of this subject would be superfluous. Fortunately, in the minds of the majority of dental and medical practitioners, root canal therapy terminating in the filling of the root canals is still considered good practice.

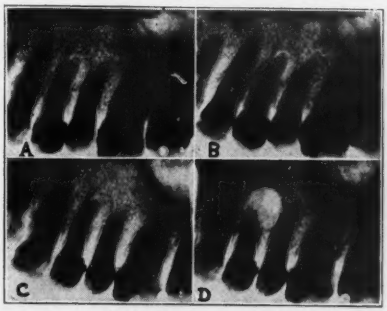


Fig. 1.—*A*, original roentgenogram. *B*, after first attempt to fill canals. *C*, after second attempt. *D*, after root amputation.

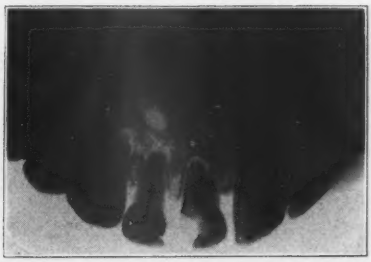


Fig. 3.—Five years after root amputation of central and lateral incisors and cuspid with chisel and mallet.

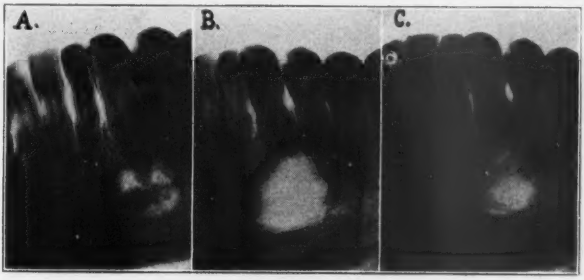


Fig. 2.—*A*, cementoma in apical region of upper cuspid. *B*, one week after root amputation. *C*, three months after operation.

*Read before the Pennsylvania State Dental Society, Pittsburgh, May 5, 1931.

These introductory remarks from a previous paper on root amputation[1] are cited here to show that my opinion on the subject has not changed. An attempt will be made to discuss briefly a few points which so often are questioned. First of all, there are some who object to the term root amputation or apicoectomy. It seems to me that a term which has been used for so many years is sufficiently well understood by the profession to warrant the continuation of its use, even though it may not satisfy everybody's wish for an exact terminology.

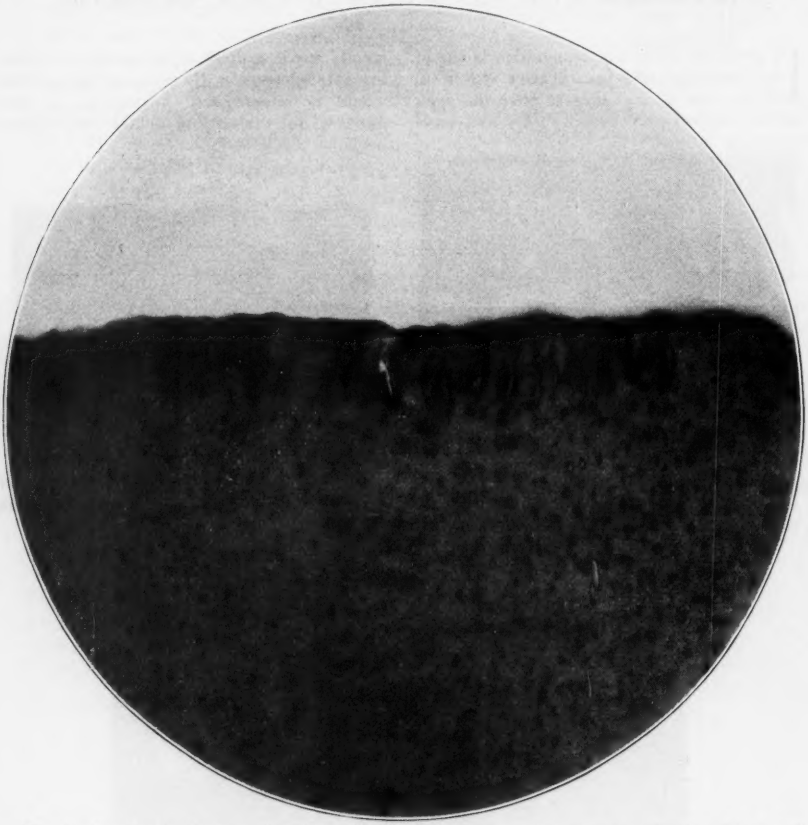


Fig. 4.—Root end of upper right lateral incisor five years after root resection by chisel and mallet. Numerous small fracture lines are present. The surface is covered by a thin fibrous layer from which thin fibers are penetrating into the fracture lines. New cementum is not yet formed.

Before deciding on root amputation, it is absolutely necessary to have a complete examination of the mouth made, which

1. Blum, Theodor: Root Amputation: a Study of One Hundred and Fifty-Nine Cases, J. A. D. A., 17:249-261 (Feb.) 1930.

should include a complete series of roentgenograms, a pulp test and transillumination, to determine whether it is good policy to advise such an operation or whether the patient would not be better off without the tooth or teeth in question. It must also be remembered that a tooth so operated on is just as liable to constitute a focus of infection as any other tooth the root canal of which has been filled.

It may be well, therefore, to return for a moment to the question of oral focal infection, and for that reason, I am taking the liberty of citing a paragraph from my paper recently read before the New York Academy of Medicine[2]:

In former years, a goodly percentage of the medical and dental profession believed that almost any ailment could be cured or at least improved by the removal of infected teeth. At the present time, the problem of oral focal infection is more conservatively treated

Fig. 5.—Root end of upper right central incisor five years after root resection by chisel and mallet. There is a quite irregular surface with smaller and deeper fracture lines and partly resorbed dentin fragment. The surface is covered by a fibrous capsule. In some portions lacunar resorption is visible.

2. Blum, Theodor: More Common Diseases of the Teeth and Jaws, Bull. New York Acad. Med., to be published.

and, therefore, a more sane mode of procedure indicated where an oral focus is suspected. First of all, there must always be cooperation between the medical practitioners and the dentist or oral surgeon. The teeth and jaws will have to be completely x-rayed, pulp tested and transilluminated and all teeth and roots not amenable to dental treatment removed, if there is no objection on account of the patient's general condition. So much should be done for every patient. If, however, not only is an oral focus suspected, but the patient is also suffering from a disease which is known to be caused by a focus or improved by the removal of the same, then, as a last resort, all devitalized teeth otherwise in good condition from the dental standpoint, as well as teeth showing gingival disturbances which cannot be cured, will have to be sacrificed. Even in those cases where a doubt exists as to the connection between an oral focus and the patient's ailment, one cannot take the chance to leave such teeth in position, and this radical procedure will have to be adhered to.

"Pathologic changes at the apical end of a tooth in the form of a thickened apical peridental membrane (so-called granuloma) and cysts in the same region do not always indicate that such teeth must be removed. In a large number of cases, such teeth remain useful for many years after the dentist has properly treated and filled the root canals and the apices as well as the granuloma or cyst have been surgically removed (root amputation). Such procedure is generally indicated in cases where no suspicion of focal infection is present, although cures of focal disease have been reported[3] with this conservative method.

Fig. 6.—Same case shown in Figure 5, but another section. There is granulation tissue invasion into the fracture lines and, after some previous resorption by which the spaces became enlarged, new cementum is deposited into them. There is a thin fibrous capsule.

Of course, it must also be mentioned here that even a vital tooth may have an infected pulp. Such teeth will unquestionably show a variation in response to the electric current when compared with

3. Lyons, C. J.: Relation of Oral Surgery to Dental Practice, Tr. Dent. Soc., New York, 1929.

the normal. My associates, Drs. Furedi and Reiss, have only recently finished an exhaustive study of the pulp test of and histopathologic findings regarding the teeth involved, which I am sure will be of great interest to the profession.

We always have to keep in mind that

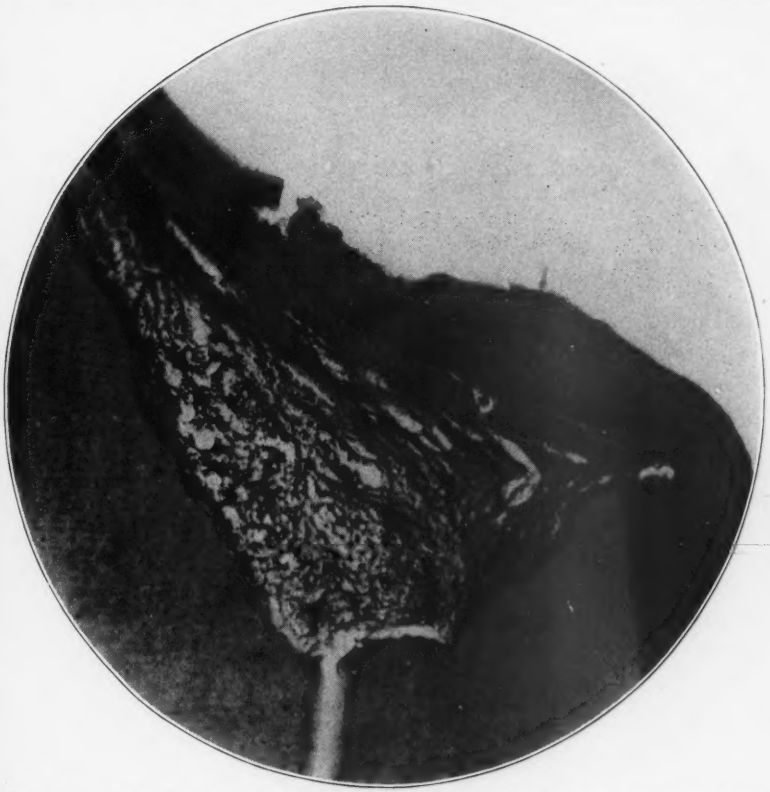


Fig. 7.—Case shown in Figures 5-6; repair at side. There is advanced resorption of dentin by granulation tissue which shows a slight round cell infiltration. Original cementum and pericementum is seen at the side, the latter bridging over the fracture space. New cementum is not deposited.

although we so often depend on what is called resistance in a patient, it certainly would be unwise to burden the system unnecessarily. Frequently, the remark is made that root canal treatment alone often cures pathologic conditions at the apex. This is true, and, in such cases, there is no indication for root amputation if the apical region as far as we can tell has become normal. On the other hand, we must admit that root canal treatment is a difficult procedure if done properly and that the larger the apical area is, the more doubtful will be the possibility of a cure by root canal therapy alone. In fact, root canal treatment is quite a problem as far as the oral surgeon is concerned, because

it is the fundamental on which to build the surgical procedure. It is useless to operate unless the root canal filling is perfect. It is often necessary, therefore, to inform the general practitioner diplomatically of the importance of this work, and then, with the consent of the general practitioner, have the patient referred to one specializing in root canal therapy. As I have so often said, the patient always comes first, and with this in mind, we must act. (Fig. 1.)

In a number of cases, there may be quite an accumulation of pus or fluid in the apical region, which constitutes a complication difficult to handle. At times, an acute condition has set in the treatment of which consists in the evacuation of pus by an incision down to and through the periosteum. Drainage is con-

Fig. 8.—Central section of root end of upper right cuspid five years after root resection by chisel and mallet. There is a guttapercha filling in the canal, covered by the fibrous capsule which can be traced to the side where a small fracture space is seen filled with granulation tissue. The thin dark bone, in accord with the newly deposited cementum at the fracture, can be traced to the opening of the canal.

tinued until the acute symptoms have subsided and the root canal can be opened, treated and filled. In cases of large cysts, the same result can be obtained by incision and irrigation of the cyst.

Some time ago, a patient complaining of tenderness in the right mandible consulted me in regard to a vital mandibular cuspid on the same side. The examination was practically negative except for the roentgenogram, which revealed a cementoma[4] in the apical region. Root amputation was advised and performed after the root canal was filled. The accompanying roentgenograms are very instructive. (Fig. 2.)

Occasionally, a doubtful case will present itself, in which the final decision as to the removal of the entire tooth and elimination of the pathologic condition

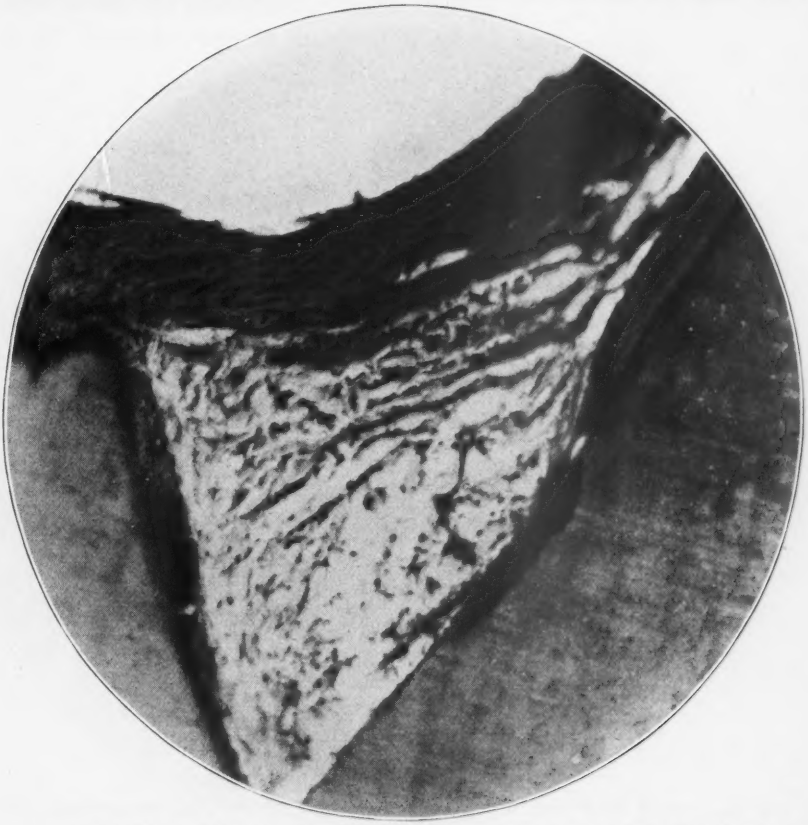


Fig. 9.—Higher magnification of fracture line seen at the side of Figure 7. There is a distinct deposit of cementum on both sides by granulation tissue, which arises from the fibrous capsule for the purpose of filling the gap of the fracture.

4. Blum, Theodor: Tumors of the Jaws, Dent. Cosmos, 73:745 (Aug.) 1931.

at the apex must, with the consent of the patient, be deferred to the time of the operation. It is best, therefore, to expose, inspect and study the apical region first and then decide on removal or resection. Never attempt the removal of a granuloma or cyst through the socket of a tooth, if they are close to a nerve (mental foramen, inferior dental canal) or to the nasal cavity and antrum. In fact, it is often difficult enough to differentiate, with these structures in view, the pathologic from the normal.

The term transalveolar surgery was explained to me as being the equivalent of root amputation except that the apex is not removed. I wish to emphasize here again that it is impossible for anyone to see with the naked eye what the condition of the apex or apical part of the root is, and that, therefore, to insure the success of the operation, the apex must be

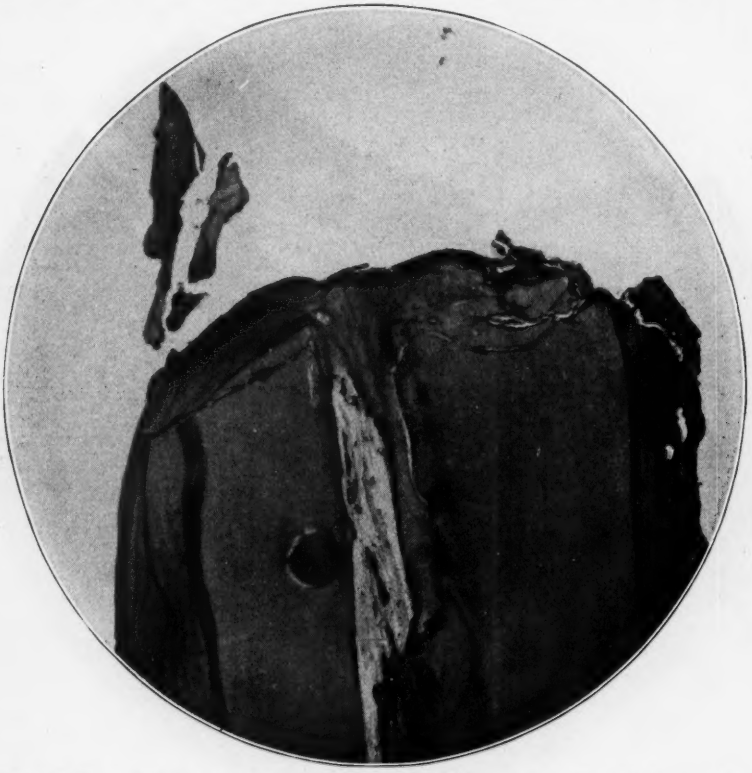


Fig. 10.—Root of lower right first molar retained fifteen years. The whole root is surrounded by a thick layer of newly deposited cementum. The fractured end of the root shows the thick secondary cementum covering and penetrating the canal, which contains pulp tissue showing some atrophy and calcific deposits. Several fracture lines in the dentin are filled with granulation tissue and in some parts with a secondary cementum.

removed and probably is best removed with a round bur starting at the apex and going down toward the neck of the tooth until the cut surface conforms with the general outline of the surrounding bone cavity. This also solves the problem of the difficulty of removing granulomatous tissue or cyst membrane from the posterior surface of the exposed root. One of the prerequisites for a root amputation is that, after the operation, enough alveolar process be left to hold in position a serviceable root. The cases must be well selected and the operation properly performed. I wish to repeat that it is immaterial whether the operator is a specialist or a general practitioner provided he is well prepared by study, observation and practice to perform such an operation. Failures are due not only to the fact that the cases may not have been well selected, but also to the lack of knowledge and the inability of the operator.

Fig. 11.—Palatal root end of upper left second molar (perhaps fractured; data were not available). There is complete repair. Secondary cementum covers the surface and lines the wall of the canal at the opening. The borderline between the dentin and the cementum shows signs of a previous lacunar resorption. Atrophied pulp tissue is seen in the canal.

For the removal of the apex, the round

bur is the instrument of choice. The chisel and mallet are entirely and absolutely contraindicated, proof of which will be seen in the accompanying illustrations. (Fig. 3.) In this case, three teeth had been operated on and the chisel and mallet employed to cut off the apices. The roots have been split by the chisel and mallet in many different places, and Nature has been burdened with the filling out of these spaces by fibrous tissue and new cement formation. (Figs. 4-9.)

The follow-up system is important and instructive. The teeth are examined by the roentgen rays, the pulp is tested and the teeth are transilluminated at frequent intervals during the first year and then once a year thereafter. If the bone cavity is filling in according to the roentgen rays and the adjoining teeth have retained

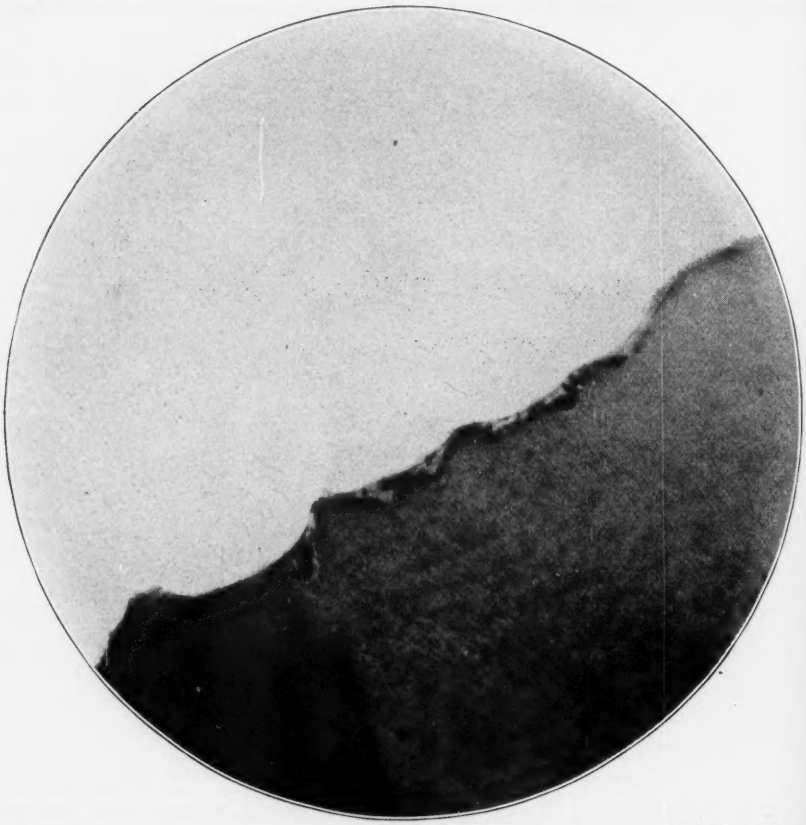


Fig. 12.—Resected root end of upper left first bicuspid twenty years after operation. There is lacunar resorption by osteoclasts (laterally). Part of the primary cementum is covered by new cementum.

their vitality, we must consider the case cured. At times, the certain stimulus to form bone after the cavity has been filled with fibrous tissue is apparently lacking, and practically no change is seen in the roentgenogram. (Cahn.)

It has often been reported that even in the so-called successful cases, bacteriologic examinations proved positive. To my mind, bacteria can be found almost anywhere, and therefore, aside from the fact that the procedure to obtain a culture is not satisfactory, such findings are not conclusive, nor do they detract from the usefulness and practicability of the operation.

Dr. Furedi, who is in charge of my medical laboratory, prepared the sections, made the photomicrographs and wrote the text for them. In addition, he wrote the following paragraphs pertaining to the histopathology of this study. The result of the operation depends on the complete eradication of infection and the formation of granulation tissue which fills the whole bony cavity. In time, this

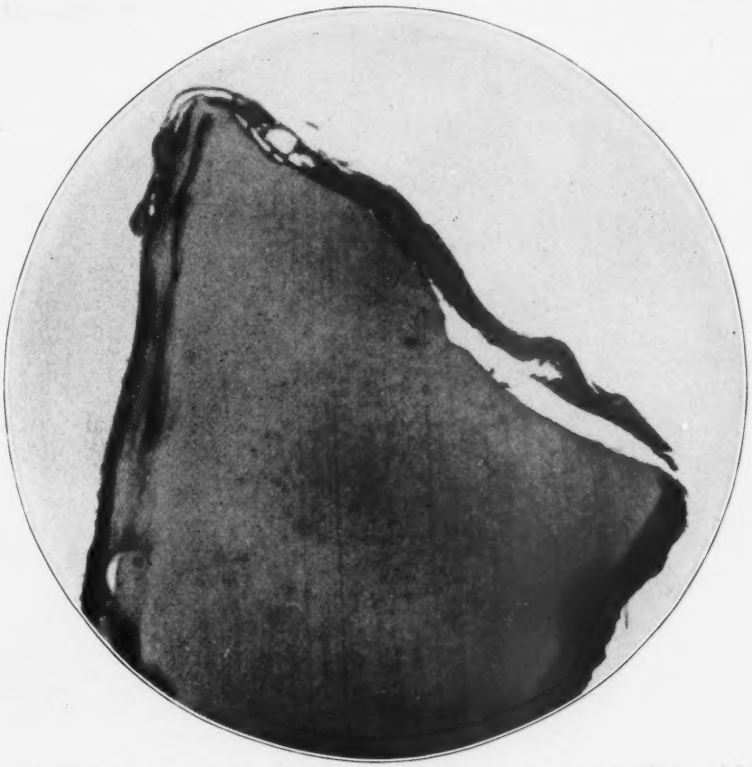


Fig. 13.—Palatal root end of upper left first molar two years after resection; peripheral section showing complete covering of the surface by fibrous capsule. A slight amount of new cementum is deposited on one side.

changes into fibrous tissue, forming bone and depositing secondary cementum over the resected surface. Complete repair, therefore, would mean restoration to normal: the dentin is covered by cementum, and space previously occupied by the apex and the granuloma or cyst is filled with bone and peridental lamella and membrane.

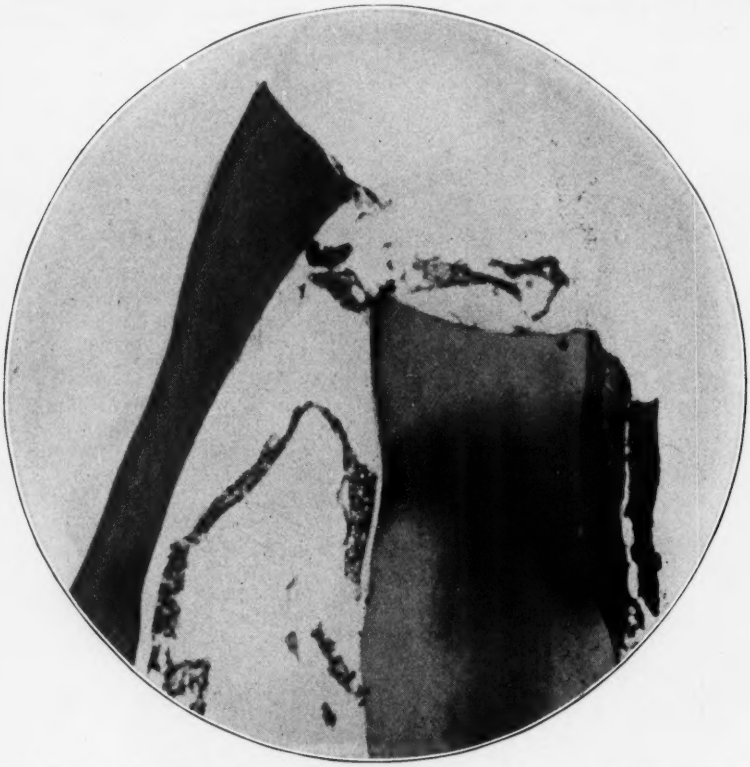


Fig. 14.—Central section of Figure 12, showing practically no repair at cut surface. A guttapercha filling in the canal partly protrudes from it.

The secondary cementum is deposited by the old pericemental fibrous tissue, which first lays as a fibrous capsule over the cut surface and, under favorable conditions, later forms cementum above both the cut cementum and the dentin surfaces. This deposit either follows a previous resorption of certain portions (portions with lower vitality—Gottlieb), the border showing lacunar resorption, or it takes place without any resorption at all.

It is generally believed that a certain degree of function of the tooth is necessary for the formation of the peridental membrane and new bone, aside from the certain stimulus for bone and cementum formation mentioned before. The follow-

ing statement of Coolidge[5] illustrates clearly our need and aim; namely, that "the knowledge of the process by which the organism mobilizes these forces of repair might be of considerable help in treatment if we could thus be enabled to engage these natural forces in cooperation with our therapy."

In our study, the majority of cases of complete repair are those where no interference at all has taken place, as, for instance, a broken root retained within the bone for fifteen years (Fig. 10), or the case of the palatal root of a maxillary second molar, which had probably been fractured some years previously. (Fig. 11.) There is complete repair as evidenced not only in the roentgenogram, but also histologically. Both pulp canals are filled with pulp tissue and there is no evidence of infection.

On the other hand, resected roots are removed only when some pathologic change requires it. Thus, our specimens all show, at the time of our study, more or less advanced inflammatory signs which have markedly disturbed the picture of repair. Among the eight teeth removed from two to twenty years after resection, very different pictures can be seen. In one case (nine years after resection), the cut surface is quite smooth and there is no sign of any new deposit or resorption. Of course, there is always a possibility that, at the time of the extraction, some portion may become separated and be left behind, but the fibrous capsule or new cementum usually adheres. In another tooth (Fig. 12), extracted twenty years after operation, the predominant feature is osteoclastic resorp-

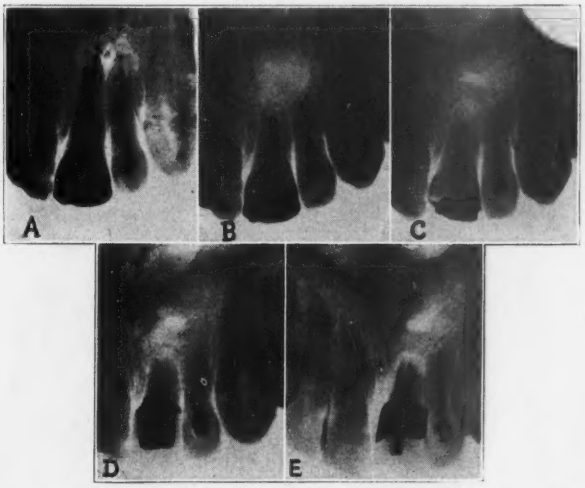


Fig. 15.—*A*, case immediately before operation. *B*, one week after operation (11-10-22). *C*, one year after operation (11-10-23). *D*, seven years after operation (9-27-29). *E*, marked change in a year (10-10-30).

5. Coolidge, E. D.: Reaction of Cementum in Presence of Injury and Infection, J. A. D. A., 18:499 (March) 1931.

tion. Usually, the peripheral portion of the root end shows more advanced repair than the part close to the pulp canal (Figs. 13-14), which makes us assume that the filling material usually exerts an unfavorable influence over the granulation tissue. Euler[6] found that, without filling material, the whole space was filled with new bone in twelve weeks; all filling materials retarded the healing process; the granulation tissue remained much longer, and new bone formation was slower.

There are two failures which I wish to report, both of them belonging to cases previously recorded. One was the case of a central incisor which, after operation, was fitted with an artificial crown in such a way that the lower teeth were striking

Fig. 16.—Root end of upper left central incisor eight years after resection; peripheral section showing complete repair of about three-quarters of surface. There is lacunar resorption of the right side. The central section shows only slight repair on the left side. Otherwise, it is covered by granulation tissue, densely packed by inflammatory cells. The canal is filled with guttapercha, but some granulation tissue and fragments of dentin are also visible.

6. Euler, H., Experimentelle Studien über den Heilverlauf nach Wurzelspitzen-resektionen und über den Einfluss verschiedener Wurzelfüllungsmaterialen auf den Heilverlauf, Deutsch. Monatsschr. f. Zahnheilk., 1923, No. 2.

against it continuously. The crown was removed and apparently, with the new preparation of the root canal for a post, a perforation occurred. With the new crown, the occlusion was not improved, the tooth loosened, a pocket was formed and the tooth was finally removed. (Figs. 15-17.) The second case was that of a mandibular lateral incisor and a cuspid operated on fifteen years previously. The patient returned in April, 1930, with a small discharging fistula on the labial side in the apical region. The root canal work was not perfect. For the purpose of our investigation, we wished to leave the root canal filling intact and had therefore decided to remove the apices and surrounding bone with a trephin. Figure 18 is a photomicrograph of the case. At present, conditions are apparently normal, although the root canals are not completely filled. (Fig. 19.)

Fig. 17.—Central section of Figure 16 showing perforation with some granulation tissue in it.

We are still enthusiastic about root amputation and feel, therefore, that the reader may be interested in a résumé of the thirty-eight cases which have been

operated on by me since the completion of the last report. My associate, H. L. Reiss, prepared the report, presented in the accompanying tabulation.

DATA ON THIRTY-EIGHT ROOT AMPUTATIONS PERFORMED SINCE OCT. 9, 1929, WHEN THE LAST REPORT WAS MADE

Male, 15 — Clinic Patients, 9
Female, 23 — Private, 29

Age — Youngest, 9 years; Oldest, 61 years; Average, 27½ years

Condition Before Operation	No. Cases
Acute apical pericementitis	1
Chronic apical pericementitis	19
Cyst (radicular)	14
Cementoma	1

Number of Teeth Involved	No. Cases
One	22
Two	9
Three	5
Four	2

Maxilla, 30
Mandible, 8
Root canals filled before operation, 37
Old root canal fillings accepted, 1
Root canals filled with guttapercha, 38
Apex removed with bur, 38
Apex removed with chisel, none
Wounds sutured, 38
Failures, none
Doubtful (slightly loose), 1
Successful, 37

Transillumination

Before	After
11, negative	11, negative
2, no record	1, shadow
25, revealed shadow	1, negative
	25, revealed shadow

Condition of Teeth After Operation†
Firm, 35
Slightly loose, 2
Loose, 1
Slightly tender to percussion, 1

Occlusion After Operation
No record, 4
Good, 35
Loss of occlusion, 1

Pulp Test of Adjoining Teeth Before Operation
Tested, 37
No record, 1

Pulp Test of Adjoining Teeth After Operation
Tested, 26
No record,‡ 12

Reaction of Patients
Pleased, 36
Not pleased, 2

†All patients were operated on under procain anesthesia.

‡Probably the case was seen too soon after operation, so no test was made.

NOTES

One patient with large cyst in the left maxilla, in which case the left maxillary central and lateral incisors, cuspid and first bicuspid were amputated, showed evidence that these teeth had become depressed, were slightly out of the occlusal plane labially and were free from occlusion. The central incisor in this case was slightly tender to percussion (six months after operation). (Fig. 20.)

Subsequent pulp tests revealed that no tooth adjacent to those operated on had its vitality impaired because of the operation.

One patient complained that there was still a lifeless feeling in the region of the amputated tooth (one month after operation on left maxillary cuspid).

One patient, who was highly nervous and unappreciative, felt that it would have been best to have removed the right mandibular first bicuspid because the operation was too much of a hardship, not realizing that the same operative procedure would have been followed even if the tooth had been removed.

In Case 24, the upper right central incisor was amputated. Six months later, when last examined, the tooth was still loose, but the patient did not complain, as he was informed prior to operation that this particular incisor was a poor risk.

Root amputation is a procedure as near the ideal as we can hope to attain. It is true that practically all the work within the field of the oral surgeon is within the reach of all classes in this respect, being so different from the work performed in the practice of general dentistry. The root canal treatment performed before the operation is somewhat easier than for the cases in which no operation is indicated, as the filling ma-

Fig. 18.—Root end of lower left cuspid with neighboring tissue fifteen years after resection. The operation and the preparation of the section caused some displacement and separation of the tissues. The place previously occupied by the root is completely filled by bone. The new peridental space is widened by inflammatory tissue, which penetrates into the canal. A small portion of the guttapercha filling can be seen. On both sides, although more on the right side, the artificially separated new cementum of the side can be traced to a fibrous capsule which covers the dentin surface.

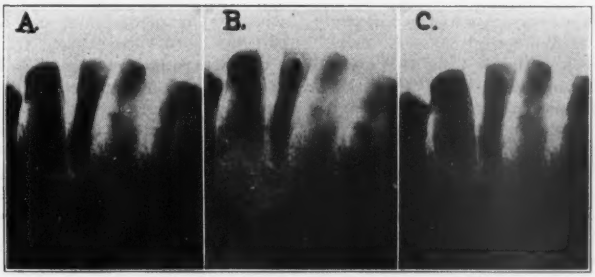


Fig. 19.—*A*, appearance of case fifteen years after first operation (4-3-30). *B*, one week after second operation (6-23-30). *C*, six months after second operation (12-17-30).

terial could be either just short of the apex or beyond without interfering with the success of the operation itself. If we can get the general practitioner to do this root canal work, the operation will not only conserve the masticatory apparatus, but will also save the patient the expense and often the annoyance associated with the wearing of an artificial substitute.

Let me repeat that I believe root amputation to be a procedure which can be highly recommended and that as long as we believe in root canal therapy, we must perform root amputations in selected cases because root amputation is nothing else but root canal therapy plus surgery.[1]

101 East Seventy-Ninth Street.

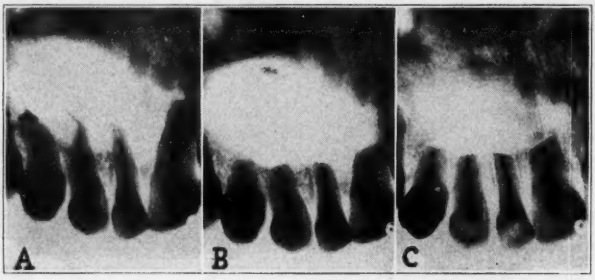


Fig. 20.—*A*, appearance of case immediately before operation (9-17-30). *B*, one week after operation (9-24-30). *C*, six months after operation (3-11-31).

CASE REPORT

By W. J. PRYOR, D.D.S., Cleveland, Ohio

IN 1921, a man came to St. Vincent's Charity Hospital with a history of having fallen from a window sixteen years previously, fracturing his right leg, right arm and jaw. Shortly after the accident, his jaw became ankylosed bilaterally, this condition continuing during the sixteen years, with the patient unable to masticate and consequently being forced to live entirely on soft foods.

The following is taken from the hospital records: "Examination shows a bilateral ankylosis, with no mobility of the mandible; a large scar on the chin near the symphysis, where apparently a portion of the bone had been removed at the time of the accident; a probable dislocation outward and backward. Only a few snags of teeth remain as a result of the accident and years of disuse."

In operating, an incision was made just in front of the tragus, dividing the temporal artery. The soft tissues were dissected forward in an attempt to save the filaments of the facial nerve. Ankylosis was complete. Part of the zygoma was removed for access, and the condyles with a portion of the neck were removed. When this was done, there was free motion. The wound was drained with a split rubber tube and sutured with catgut.

The operating surgeon, C. A. Hamann, remarked that the greatest difficulty in this operation lies in the danger of severing the facial nerve which emerges at this point. In this case, on the left side, one of the superior branches supplying the orbicularis palprebrarum and forehead was severed, a temporary paralysis of the parts resulting. This condition had since disappeared.

About a year after this operation, full upper and lower dentures were constructed

for the patient, and from the start he has been able to masticate satisfactorily, the result in this case being more successful than in the average normal denture case. There is a clearance of at least an inch between the upper and lower artificial teeth when the mouth is opened wide. The power of the bite was measured on G. V. Black's gnathodynamometer and registered from 15 to 20 pounds pressure in the cuspid region, which is very good for a patient wearing artificial dentures. The strength of the bite in the molar region could not be measured, there being insufficient clearance to admit the instrument.

An interesting point in regard to this case is the fact that the mandible cannot be protruded, because the external pterygoid muscles which normally carry the jaw forward were severed at the point of their insertion into the interarticular cartilage and the neck of the condyle in removing the condyles. On the other hand, there is considerable range of movement backward, there being no condyles to prevent it. This creates a condition which is practically a reversal of masticatory movement, the range of movement being from the rear forward to centric relation. Probably no other human joint could function so well with its condylar member missing.

The case was examined very recently, and it was unusual that the original dentures were still functioning in centric relation to each other after almost ten years of use. I have never observed a similar condition in an artificial denture case with a normal temporomandibular articulation. Here, because of shrinkage of the ridges and the consequent closing of the bite, centric relation of the dentures is lost (the lower denture gradually working into a protrusive relation). This no doubt was a result of the presence of the condyles.

The late Mr. Rudolph Hanau once commented that this case demonstrated why the condyles should be taken into consideration in constructing artificial dentures. This case was shown at the meeting of the National Society of Denture Prosthetists at Milwaukee in 1921 and checked up at the Cleveland meeting in 1923.

669 Rose Building.

THE DEVELOPMENT OF PHYSICAL TESTING OF DENTAL MATERIALS AND SPECIFICATIONS FOR TESTING METHODS*

By WALTER S. CROWELL†, B.S., Philadelphia, Pa.

HISTORY

THE question of the physical testing of dental materials is now very prominently before the dental profession. It is not an entirely new departure either for the profession or for the manufacturers of dental supplies.

In the work of G. V. Black[1] on amalgam, physical measurements were used as a means of research and as specifications for a dental material, amalgam alloy. Dr. Black emphasized the neces-

*Public report of the Gold Section of the American Dental Trade Association.

†Secretary of the Technical Committee, Gold Section, A. D. T. A.

1. Black, G. V.: Investigation of Physical Characters of Human Teeth in Relation to Their Diseases, and to Practical Dental Operations, Together with Physical Characters of Filling Materials, Dent. Cosmos, 37:353-422 (May); 469-484 (June); 553-572 (July); 637-661 (Aug.); 737-757 (Sept.) 1895.

sity for making physical tests and using test data to insure the uniform excellence of a product and to take care of variations in raw materials and in manufacturing processes.

The importance of physical tests of amalgam was immediately recognized by manufacturers and dentists, and these tests have been made both for routine inspection purposes and for comparing various brands or formulas of amalgam alloy for many years.

With the exception of occasional articles on amalgam, dental literature, and, in fact, scientific literature in general, was for many years signally lacking in references to determinations of the physical properties of dental materials. An outstanding exception is the work of Poetschke[2] on dental cements. Unfortunately, this appeared in a journal seldom read by members of the dental profession and did not receive the attention it deserved. Van Horn's[3] articles on the dental casting process indicate the necessity for knowing the physical properties of the materials used, but no numerical data are given. Price,[4] writing on the same subject, went a step farther, publishing the results of his physical measurements.

It must not be thought that physical and chemical research on dental materials was confined to the published work. Manufacturing in all lines has progressed by the application of science to industry. Meeting the needs of the dental profession is distinctly a technical pursuit. It is not strange that many producers of dental materials have maintained research departments for a quarter of a century or more. In some cases, these departments have been established so long that they have ceased to be novel enough to be given publicity in advertising. They are taken as a matter-of-course part of the establishment, quite as necessary but no more unusual than power plants, automatic machines or any other production facility. Little of the work of these laboratories has found its way into the scientific periodicals. Most of the subjects studied are not of interest to scientists in general because of the specialized field in which dental products are used, the small tonnage produced and, frequently, the rarity and costliness of the materials employed.

The excellence of American dental supplies and equipment and the profusion of products available and their superiority to those originating abroad cannot be wholly attributed to Yankee inventiveness and manufacturing genius. Credit must be given to a large number of technical men, mostly anonymous, whose painstaking work was and is the scientific background of the industry and the assurance of the quality and uniformity of its products.

It is interesting to note that amalgam, which, about thirty-six years ago, presented a striking example of the application of physical measurements to the solution of a dental problem, is also the

2. Poetschke, Paul: Germicidal Efficiency of Dental Cements, J. Indus. & Eng. Chem., 7:195 (March); 1000 (Nov.) 1915; Physical Properties of Dental Cements, ibid., 8:302 (April) 1916.

3. Van Horn, C. S.: Some Phases of Casting Process, Dent. Cosmos, 51:546-555 (May) 1909; Castings: Review and Commentary, Including Technique, ibid., 52:873-882 (Aug.) 1910; Concerning Casting Methods and Casting Devices, ibid., 53:664-671 (June) 1911; Standardizing the Investment Process and Simplifying the Casting Process, ibid., 53: 1109-1119 (Oct.) 1911; Casting Failures and Remedies, ibid., 54:890-895 (Aug.) 1912; Wax Pattern: Technique Together with Appliances, Etc., for Execution, ibid., 54:973-987 (Sept.) 1912.

4. Price, W. A.: Laws Determining Behavior of Gold in Fusing and Casting, Dent. Cosmos, 53:265-295 (March) 1911.

subject of a paper which marks the beginning of the application of exact methods of determining physical properties to the problems of dentistry.

During the World War, when the military authorities were purchasing large quantities of dental materials for use in camps and hospitals here and overseas, the problem of developing tests and specifications for them was turned over to the scientists at the National Bureau of Standards. The testing of dental amalgam was assigned to Souder and Peters.[5] Their paper on the subject, describing the interferometer method of making measurements of setting expansion, and detailing their determinations of the other properties, brought before the present generation of dentists the scientific value and practical utility of exact knowledge of the properties of the material that they are using. These papers, those of Gray[6] and, more recently, those of Taylor[7] very completely describe the properties of the currently sold amalgam alloys and have established the present American Dental Association specification for amalgam alloy, in which exact physical and chemical measurements are relied on to establish the quality and utility of this important filling material.

Souder, Peters and Weinstein, realizing the lack of exact information on the precious metal alloys used in prosthetic dentistry in various fabricated forms and the mystery surrounding the art of dental casting, set about to supply this need. Through their efforts at the Bureau, quite properly the research fellows, Coleman, Swanger and Poppe, were placed under the direct supervision of Wilmer H. Souder, who was already familiar with dental problems. The publications of Souder and Coleman and their associates, working under the Weinstein research fellowship,[8] are outstanding contributions to the quantitative study of the precious metal alloys used in dentistry and methods of testing them to determine their useful properties. They have largely influenced the work of subsequent investigators, aroused widespread interest in the properties of materials among dentists and played a conspicuous part in the development of purchase specifications by the various governmental departments using such materials. A summary of the work of the Weinstein research fellowship was published as Research Paper No. 32 by R. L. Coleman.[8]

The attention attracted by the publication of this work created a demand for more complete information on the properties of materials in daily use and for the standardization of supplies and methods for making dental restorations so insistent that, in 1928, the American

5. Souder, W. H., and Peters, C. G.: Investigation of Physical Properties of Dental Materials, Dent. Cosmos, 62:305-336 (March) 1920.

6. Gray, A. W.: Metallographic Phenomena Observed in Amalgams, J. N. D. A., 6:513-531 (June); 909-925 (Oct.) 1919; Transition Phenomena in Amalgams, ibid., 8:196-207 (March) 1921.

7. Taylor, N. O.: Survey of Amalgam Alloys: Report to Research Commission of A.D.A., J.A.D.A., 16:590-600 (April) 1929.

8. Coleman, R. L.: Physical Properties of Dental Materials, J.A.D.A., 12:520-547 (May) (1925); Dent. Cosmos, 68:743-764 (Aug.) 1926; ibid., 69:1007-1026 (Oct.) 1927; Research Paper No. 32, Bur. Standards J. Res., December, 1928, pp. 867-939.

Souder, W. H.: Physical Properties of Dental Materials, J.A.D.A., 12:509-519 (May) 1925; Summary of Reports on Dental Alloys, ibid., 15:627-631 (April) 1928; Selection of Dental Materials, ibid., 14:189-200 (Feb.) 1927; Physical Properties of Dental Materials, ibid., 16:1829-1844 (Oct.) 1929.

Swanger, W. H.: Analysis of Dental Gold Alloys, Sc. Papers Bur. Standards, No. 532, Aug. 11, 1926.

Dental Association took over and continued the work of the Weinstein fellowship under the direction of the American Dental Association Scientific Foundation and Research Commission. Active supervision of the work remains in the hands of Dr. Souder, now assisted by two research fellows appointed by the American Dental Association and by members of the Bureau staff assigned to the work.

REASONS FOR TESTING

The interest of the dental profession in the physical characteristics of the materials which they use has been keenest in connection with precious metal products. These products are chiefly used for what can be properly termed structural purposes, frequently under most exacting conditions. Physical properties and the effect of the ordinary manipulations of fabrication on them are far more important than precious metal content or intrinsic value.

Physical tests of structural materials are made for the purpose of predicting their structural usefulness or suitability for a given purpose and as a means of comparing one material with another. Physical tests, also a valuable tool of research, are used by the scientist to verify theories and to determine natural laws, and by the manufacturer to develop improved materials. The testing of structural materials has become a special division of engineering, of such importance that a national society, the American Society for Testing Materials, has been formed to organize and standardize testing and promote the free exchange of ideas and information among those interested. Methods of determining or estimating the important properties of materials, the significance of tests and the practical application of test results have been worked out and proved by years of use. A terminology has grown up, from the same necessity for exactness experienced by other professions, perhaps as strange and incomprehensible to those not familiar with this branch of science as the terminology of dentistry is to the layman.

NEED FOR STANDARDIZATION

The testing of dental products of precious metal is the same in principle as the testing of other structural materials. Because of the small size of the structures used in practice, it is a special case of structural material testing. It is popularly believed that the strength of a structure can be determined by testing a piece of material of convenient size and calculating the strength of the structure from the test results, the dimensions of the test specimen and the dimensions of the structure. Results so obtained might be far from true. The shape and size of the test piece have a marked effect on the numerical value of the test results, particularly when small sizes are tested or used. Test pieces must not differ greatly in dimensions from the pieces actually used in the dental structure. That is, if we wish to determine the strength of an orthodontic arch 0.040 inch in diameter, we must do so by testing a sample of wire of nearly the same diameter, not by testing a bar an inch in diameter or a wire 0.001 inch in diameter. The effect of the diameter of the test piece on strength is graphically shown by the accompanying chart (from Jefferies[9]). It is also important to test materials in the conditions in which they are actually used. Thus, tests of a casting gold alloy in wrought wire form are useless for predicting the strength of a cast structure.

9. Jefferies, Z.: Effect of Temperature, Deformation and Grain Size on Mechanical Properties of Metals, Am. Inst. Min. and Metallurg. Engineers, 60:474, 1919.

Physical test results may be correct in themselves, but not comparable with each other. Size and condition of a specimen have been mentioned in this connection. Other factors must be taken into account. For instance, there are several methods commonly used to measure hardness, each with a different scale of numbers representing variations in hardness. Hardness numbers cannot be compared unless determined by the same method or when a known law relates the methods used. The rate at which a test is made affects results and must be controlled. Measurements of elongation must be made over the same gage length. Numerous other examples might be given to show the effect of test conditions and test methods on numerical results, but enough have been presented to show that if comparisons of test results are to be made, methods and conditions of test must be carefully considered, and should, if possible, be identical.

This principle has long been recognized by testing engineers. In fact, the standardization of tests and test methods is one of the chief activities of the American Society for Testing Materials. If tests are to be used to predict structural usefulness or compare one material with another used for the same purpose, the following principles must be observed:

1. Test specimens and methods must conform as nearly as possible to the conditions of actual use, particularly in regard to size of specimen, condition (wrought or cast), heat treatment, method of loading and rate of application of load.

2. Tests must be run in a uniform manner, so accurately described that they can be duplicated both by the same worker and by others.

3. Tests are not comparable unless made by the same method, or unless the extent to which changes in test methods affect results is known.

4. Tests must be planned so that unavoidable errors are small, giving results that are sufficiently constant to permit duplication and sufficiently accurate to be practically useful.

It is obvious that the standardization of tests and test methods benefits both manufacturer and consumer. When such standardization has been made and adhered to, all published data will be obtained under similar and reproducible conditions. Direct comparisons of competing products can be made without fear of error or misunderstanding.

SIGNIFICANCE OF TESTS

The dentist is primarily interested in certain practical matters concerning the structure which he builds. He would like to know that its strength is adequate not only to prevent failure, but also to give service without distortion. He would like to have knowledge of the workability of his material to aid him in forming his structure. He is interested in the lightness of his structure from the standpoint of comfort to the patient, and, finally, he is interested in the cost of the structure both to himself and to the patient. If physical test data will enlighten him on any or all these practical points, he is vitally interested in such data. Conversely, data which will not so enlighten him have no interest for him. Such practical interpretation can be made wholly or in part from physical test data at the present time, even by the comparatively uninitiated.

As a matter of fact, physical test results as published embody the quantitative strength, stiffness and workability of a particular type of structure (tensile test piece) loaded in a particular manner. It would appear then that

these results are exactly the things which the dentist has been looking for. Since such results are dependent, not only on the material from which the structure is built, but also on the form of the structure, their interpretation in terms of the same properties of the finished dental structure of different type is not so easy as might be supposed. While the structure used in obtaining physical test results is comparatively simple, many of the structures used in dental practice are highly complicated from a structural standpoint, and their analysis involves laws which are a science in themselves. Their understanding would require a considerable course of training in this science. It is to be hoped that eventually such courses may be provided in dental schools. In fact, their beginnings are to be observed in certain schools at the present time.

In the meantime, while the dental profession is preparing itself with this information regarding structure, have these physical test results any significance to the members of the profession not so prepared? The answer, undoubtedly, is that they have. The dentist can use the results, with due caution, in a general sense, to his decided advantage. There are certain universal principles which are easily mastered, and which will be of decided assistance to him.

For instance, while he should have a full realization of the complications which the form of a structure offers to complete analysis, he may also know that these complications are no bar to comparing the structure to itself. That is, he may compare the structure made of one material to the same structure made from a different material successfully on all points because the structural difficulties cancel each other in such a comparison. If he is familiar with the fundamental fact, that elastic strength is limited by proportional limit of material, he may compare the elastic strengths of the same structure from different materials by comparing the proportional limits of the materials. He may similarly compare the breaking strengths by comparing the ultimate strengths of the materials. He may compare resistance to breakage from impact within the breaking strength by comparing products of ultimate strength and percentage of elongation for his materials. He may study the effect of altering dimension on strength and stiffness. He may compare bulks of structure, weights of structure and costs of structure.

In fact, there is almost no limit to the things that he may know about a structure on a comparative basis. Certainly, this information is directly valuable to the dentist, and as the realization of its value accumulates, the physical properties of the materials which he uses will become more and more essential to him in his daily practice.

DEVELOPMENT OF TESTS BY THE GOLD SECTION OF THE AMERICAN DENTAL TRADE ASSOCIATION

It is natural that the manufacturers of precious metals, where the dentist's interest in physical characteristics first centered, should be first to publish physical data on their products and first to standardize among themselves tests and test methods.

At a meeting of the Gold Section of the American Dental Trade Association, in New York, May 20, 1929, the following motion was passed:

That in view of the increasing importance of methods of testing dental golds and the resulting physical properties to the dental profession, an agreement should be reached as to certain fundamental principles in connection with definitions, methods of arriving

at, and interpretations of such results. And that, further, the matter of formulating a definite agreement of this sort be brought before a group of technical men representing the various manufacturers of the Gold group; this action to be taken in cooperation with representatives of the American Dental Association and the Bureau of Standards.

The technical committee immediately convened. R. C. Brumfield was elected chairman, and W. S. Crowell, secretary. The committee included in its membership Louis J. Weinstein, R. L. Coleman, R. V. Williams and O. E. Harder, all pioneer contributors to the literature on precious metal dental products. Homer C. Brown and N. O. Taylor, of the American Dental Association, and Wilmer Souder, of the Bureau of Standards, were present at the meeting and invited to participate in its deliberations.

The committee set itself (1) to classify dental precious metal products; (2) to determine the physical properties required to describe adequately the structural usefulness of each class, and (3) to work out definitions of terms and test methods to define accurately and determine the physical properties.

The committee was unable to complete its task in one meeting. Correspondence between the members and a second meeting were required before a preliminary report could be drafted. This report was submitted to the Bureau of Standards and the American Dental Association for criticism. After revision, the final report was submitted to the members of the Gold group and was unanimously approved.

Tests and test methods can seldom be fixed for all time. We know that, as knowledge of the precious metal alloys used in dentistry increases and the technic of making dental appliances improves, revisions will be necessary.

SIGNIFICANT PHYSICAL PROPERTIES AND STANDARD METHODS OF TEST OF PRECIOUS METAL DENTAL PRODUCTS ADOPTED BY THE GOLD GROUP, AMERICAN DENTAL TRADE ASSOCIATION

A. Classification of Precious Metal Dental Products.—For convenience of discussion, precious metal dental products are divided into the following five classes: (1) wrought wires, (2) wrought plates, (3) casting golds, (4) solders and (5) fabricated articles.

B. Classification of Physical Properties.—The significant physical properties of these products are divided into three classes:

1. Major properties: Those considered to be necessary to adequately describe the materials. It was agreed that if physical properties are advertised for precious metal dental products, all the major properties shall be published.

2. Minor properties: Those recognized as important under certain circumstances. The values for minor properties may be given by manufacturers, but are not recognized as essential for all materials.

3. Deferred properties: Those properties which may be important but for which definitions or methods of testing are not readily available.

C. Definitions.—To make data on various materials more readily comparable, the following definitions are given in the customary English units, inches and pounds, etc.

1. Proportional limit: The greatest stress in pounds per square inch which a material is capable of developing without a deviation from the law of proportionality of stress to strain (Hooke's law).

2. Ultimate tensile strength: A maximum tensile stress in pounds per square inch developed in a material when tested to rupture in tension, stress being computed on the basis of the original cross sectional area.

3. Modulus of elasticity: The ratio, within the proportional limit of a material, of stress in pounds per square inch to corresponding strain in inches per inch.

4. Modulus of resilience: The potential energy in inch pounds per cubic inch that is stored in a material stressed to the proportional limit.

5. Percentage elongation: The percentage increase in length of a standard gage length of a tensile test specimen measured after rupture in tension.

6. Hardness: It is agreed that hardness shall be expressed as Brinell number.

7. Melting range of a material: The temperature range in which the material passes from the fully solid state to the fully liquid state.

8. Fusion temperature, wire method: This is defined under "Methods of test."

9. Temperatures must be published in degrees Fahrenheit. They may be given in both Fahrenheit or centigrade, at the option of the manufacturer.

10. Heat treatment: The following heat treatments are recognized: (a) quenched, (b) air cooled, (c) oven cooled and (d) optional heat treatment.

The quenched condition is produced by heating the specimen to a minimum temperature of 1292 F. and quenching in water at room temperature.

The air cooled condition is produced by reheating the quenched specimen to 1292 F., removing from the furnace and cooling by hanging vertically in still air.

The oven cooled condition is produced by reheating quenched material to 842 F. and cooling it from this temperature to 482 F. in thirty minutes.

"Optional heat treatment" refers to any other heat treatment of quenched material specified by the manufacturers.

It is agreed that tensile properties and Brinell number, when major properties, be published on quenched specimens and air cooled specimens by all manufacturers, but that it is optional with the manufacturer whether he shall publish results on oven cooled specimens or on specimens given the optional heat treatment. Results from the optional heat treatment shall not be published as "oven cooled," but as obtained from the optional heat treatment specified and recommended by the manufacturer of the product.

D. Outline of Physical Properties.—1. Wrought wires: (*a*) Major properties: (1) ultimate tensile strength, (2) proportional limit, (3) percentage elongation and (4) fusion temperature, wire method.

(*b*) Minor properties: (1) modulus of elasticity, (2) modulus of resilience, (3) Brinell number and (4) melting range.

(*c*) Deferred class: (1) color, (2) tarnish resistance, (3) corrosion resistance, (4) fatigue or endurance limit and (5) repeated dead load flexure tests.

2. Wrought plates: (*a*) Major properties: (1) ultimate tensile strength, (2) proportional limit, (3) percentage elongation, (4) Brinell number and (5) fusion temperature, wire method.

(*b*) Minor properties: (1) modulus of elasticity, (2) modulus of resilience and (3) melting range.

(*c*) Deferred class: (1) color, (2) tarnish resistance, (3) corrosion resistance, (4) fatigue or endurance limit and (5) repeated dead load flexure tests.

3. Casting golds: (a) Major properties: (1) ultimate tensile strength, (2) proportional limit, (3) percentage elongation, (4) Brinell number and (5) melting range.

(*b*) Minor properties: (1) modulus of elasticity, (2) modulus of resilience and (3) fusion temperature, wire method.

(*d*) Deferred class: (1) color, (2) tarnish resistance, (3) corrosion resistance, (4) casting shrinkage, (5) cold bend test, (6) fatigue or endurance limit and (7) repeated dead load flexure tests.

4. Solders: It was agreed that solders should be tested for the properties and by the methods outlined for casting gold.

5. Fabricated products: The physical properties of these products, whenever possible, are defined as those of the alloy from which they are made, in the condition in which it appears in the product.

E. Methods of Test.—I. Tensile test: Proportional limit, ultimate tensile strength, modulus of elasticity, modulus of resilience and percentage elongation shall be determined from the results of a series of tensile tests. The values published shall all be from the same specimens. In the case of casting golds, the published values shall be the average of three or more of a series from five specimens.

The details of carrying out the test shall conform as far as possible to A.S.T.M. "Tentative Methods of Tension Testing of Metallic Materials, Series E8-27T," pp. 815-819, modified by the specifications and notes given below.

(*a*) Test specimen: (1) Wrought wires: (*a*) Diameter, 0.030 to 0.045 inch. (*b*) Gage length, 8 inches. (*c*) Distance between clamps or grips, 9 inches minimum.

(2) Wrought plates: (*a*) This specimen shall be made from flat stock 0.007 to 0.010 inch thick. It shall have a straight parallel portion at least 9 inches long and 0.250 inch wide. The ends can be enlarged or not as desired. (*b*) Gage length 8 inches. (*c*) Dis-

tance between clamps or grips 9 inches minimum.

(3) Casting gold: (*a*) Diameter, 0.070 to 0.090 inch. (*b*) Gage length, 2 inches. (*c*) Distance between clamps or grips, 3 inches minimum. (*d*) The specimen must be cast in dental investment compound, by any generally accepted dental method, except that the use of a wax pattern is not required. The specimen can be prepared for test by the removal of fins and nodules, but the original surface or skin of the casting must be left intact as far as possible.

(*b*) Extensometer: (1) Wrought wires: An extensometer which averages the elongations on two sides of a specimen is not required. It must have an accuracy of 0.0005 inch.

(2) Wrought plate: An extensometer which averages the elongations on two sides of a specimen is required. It must have an accuracy of 0.0005 inch.

(3) Casting gold: An extensometer which averages the elongations on two sides of a specimen is required. It must have an accuracy of 0.00025 inch.

(*c*) Increment of strain: For all specimens, the increment of strain in the neighborhood of the proportional limit must not exceed 5 per cent of the total deformation between no load and the proportional limit, and in no case should the increments of strain exceed 20 per cent of the total at the proportional limit.

(*d*) Testing machine: In making determinations of proportional limit or modulus of elasticity, the data used shall have been obtained from a testing machine, the accuracy of which, in the case of wrought wires, is ½ pound and, in the case of cast specimens, is 2½ pounds.

(*e*) Graphs: In plotting the stress-strain diagrams, the scales of stress and strain shall be such that the angle of the straight portion of the curve with the strain axis shall not exceed 70 degrees.

In drawing the stress-strain curve, slight irregularities, which may exist in the plotted points, from zero strain to 20 per cent of the proportional limit, may be ignored. The remaining straight portion of the curve shall be the straight line which best represents the plotted points below the proportional limit.

(*f*) Computing results: (1) Proportional limit, modified Johnson method: The proportional limit is determined from the stress-strain diagram plotted as described above.

Referring to the diagram herewith: The initial rate of deformation is given by the ratio mn/om. Lay off mr=1.25 mn. Draw or. Then the slope of or represents a rate of deformation 25 per cent greater than the initial rate. Draw o'r' parallel to or and tangent to the stress-strain diagram. The point of intersection, J, of o'r' and the straight portion of the stress-strain diagram extended locates the proportional limit.

(2) Ultimate tensile strength= $\frac{\textit{Maximum load}}{\text{Original cross sectional area}}$ pounds per square inch.

(3) The modulus of elasticity is determined by computing the ratio of stress to strain represented by the slope of the straight line which best represents the plotted points below the proportional limit.

(4) The modulus of resilience is determined by calculation, as follows:

K = modulus of resilience

S_1 = stress at the proportional limit in pounds per square inch.

E = modulus of elasticity

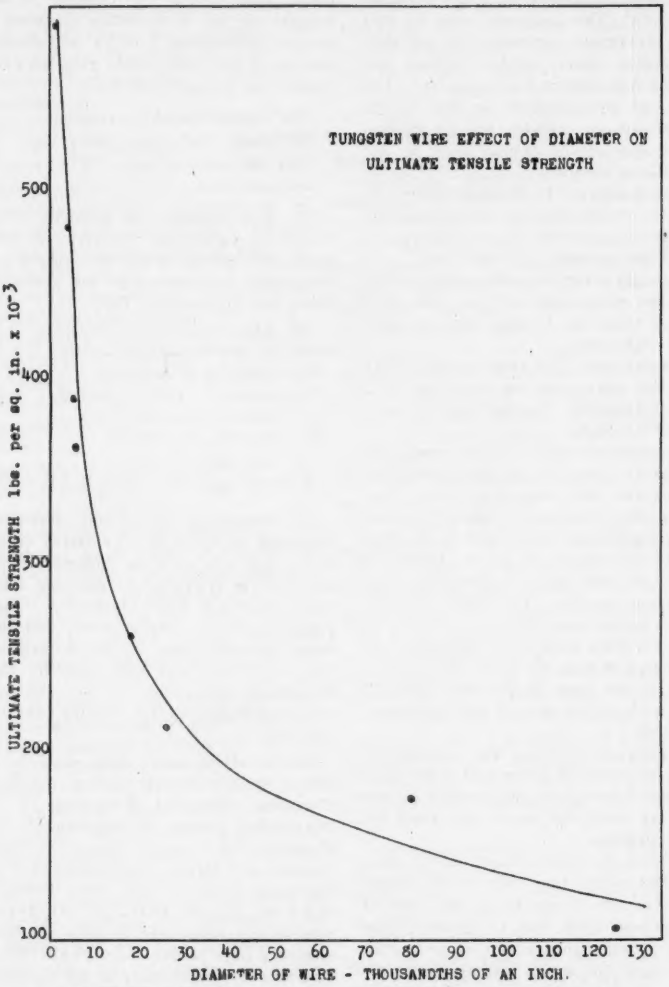
$$K = \frac{S_1^2}{2E} \text{ inch pounds per cubic inch}$$

(5) Percentage elongation: Determine as indicated in A.S.T.M. "Tentative Standards, Series E8-27T," and as follows: After the specimen is fractured in the test, the fractured ends are fitted together as closely as possible without forcing them, and the distance between gage marks is measured in inch units and with such accuracy that the percentage elongation can be expressed to two significant figures or the nearest 0.1 per cent.

II. Brinell number: This shall be determined by the Brinell method described by Coleman: "Physical Properties of Dental Materials," *Bureau of Standards Journal of Research*, Vol. 1, p. 867, December, 1928, and Goodale and Banks; "Development of Brinell Hardness Tests on Thin Sheet Brass," *Proc. A.S.T.M.*, Vol. 19, Part 2, p. 757, 1919. The type of apparatus used is optional. Use one-sixteenth inch hardened steel ball. For alloys having a Brinell number of not exceeding 50, use a load of 6.4 kg.=14.1 pounds. For alloys having a Brinell number over 50, use a load of 12.8 kg.=28.2 pounds. The load is applied for thirty seconds. The minimum thickness of the specimen tested must be 0.007 inch, and in no case should results be re-

ported when the impression of the ball shows on the opposite side of the plate.

III. Melting range: The determination shall be carried out on a sample weighing not less than 100 gm. by the inverse rate method described in Hoyt: "Principles of Metallography," Part 1, p. 153, *et seq.*, first edition, 1920, Rosenhain: "Introduction to Physical Metallurgy," p. 83, *et seq.*, second edition, 1919, U. S. Bureau of Standards Tech. Paper No. 170, p. 200, *et seq.*, and Merica: Bull. American Institute of Mining and Metallurgical Engineering, July, 1919. The type of furnace used and other experimental details are optional. Results must be accurate to ±18 F.


TUNGSTEN WIRE EFFECT OF DIAMETER ON
ULTIMATE TENSILE STRENGTH
ULTIMATE TENSILE STRENGTH lbs. per sq. in. x 10⁻³
500
400
300
200
100
0 10 20 30 40 50 60 70 80 90 100 110 120 130
DIAMETER OF WIRE - THOUSANDTHS OF AN INCH.

Tungsten wire effect of diameter on ultimate tensile strength.

IV. Fusion temperature, wire method: The fusion temperature is the lowest temperature at which a wire of 0.0285 to 0.032 inch diameter and one-sixteenth inch long, supported at both ends, will break when subjected to a cross bending load of 3 ounces avoirdupois. The heating rate, within 90 F. of the breaking point, shall be between 9 and 54 F. per minute. The test is made by fusing or welding a piece of the alloy wire under test, of the proper diameter and length, between the two wires of a platinum; platinum-rhodium thermocouple, so that the two welds or fused balls are separated by one-sixteenth inch of wire. The 3-ounce weight is attached to the alloy wire by means of a hook of platinum wire and the assembly placed horizontally or vertically in a suitable furnace. The ends of the thermocouple are attached to a suitable voltage measuring device and the temperature of the furnace raised until the wire is broken by the weight. The highest voltage obtained across the thermocouple, converted into temperature, gives the temperature at which the wire breaks, which is called the fusion temperature, wire method. The errors of the instruments used in measuring the temperature shall not exceed ±9 F.

DENTAL INFECTIONS AS FOCI OF SYSTEMIC DISEASES IN CHILDREN*

By JULIUS H. HESS, M.D., Chicago, Ill.

FOR an evaluation of the effect on tooth development of congenital disease, malnutrition and infections in the mother prenatally and in the infant after birth, it is necessary to have definite knowledge as to the manner in which and time that the various tooth structures are formed. Such information can be applied with definiteness in establishing a chronologic analysis of the various forms of hypoplasia.

The development of the deciduous teeth begins at about the sixth week of fetal life. At about the ninth week, the dental lamina begins to develop enlargements along the free border. These are ten in each jaw. Toward the end of the fourth month, deposition of lime salts begins; after which the process of calcification progresses from the enamel toward the pulp. The papilla of the first permanent molar appears at about the seventeenth week of fetal life, those of the permanent incisors and cuspids at about the twenty-fourth week and the bicuspids at about the twenty-ninth week.

The second molars do not appear until after birth, at about 6 months. The third molars begin to develop at about the fifth year.

PRENATAL AND POSTNATAL CONDITIONS AFFECTING TOOTH DEVELOPMENT

At birth, there are forty-four teeth in the process of development in the jaws, including twenty deciduous teeth, twenty permanent teeth and four additional dental follicles from which the four first permanent molars are formed. The crowns of the deciduous teeth alone are in varying stages of calcification, while the enamel and dentin of the permanent teeth are not formed until some time after birth.

In a study of twenty-five normal newborn and still-born infants, Bunting states that not in a single instance was

*Read before the Section on Mouth Hygiene at the Midwinter Clinic of the Chicago Dental Society, Feb. 3, 1931.

there any indication of calcification in the first permanent molars, the first tooth of this series to develop. The question of calcification in this tooth has, I believe, been the subject of considerable discussion. He further states that the dental follicles of the permanent teeth in his anatomic studies consisted solely of soft embryonic tissue in which no enamel or dentin had been formed.

may arise, first, from inherited tendencies, at times seen in several members of the same family.

The number of conditions influencing the health of the parents, and which may thereby secondarily affect the fetus, are many. Among those especially worthy of mention as affecting the mother are malnutrition, avitaminosis, syphilis, tuberculosis, diabetes, nephritis, the blood

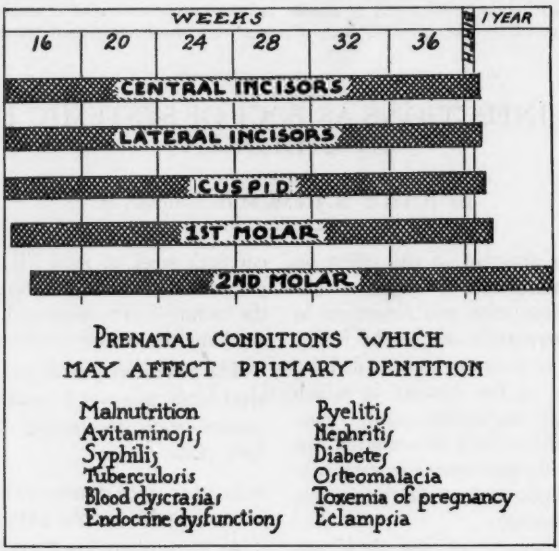


Fig. 1.—Inception and duration of enamelization in the primary dentition.

We are all agreed that during the development of the teeth in the fetus and during postnatal life, many disturbances of the normal physiologic processes may occur which may cause pathologic changes in the first and second dentitions. Deviations from the normal formation of the teeth consist of hyperplasia, hypoplasia and atypical arrangement of the dental tissues. These abnormalities are produced by disturbances of the function of the dental formative organ during the period of its activity. These disturbances

dyscrasias, endocrine dysfunction and osteomalacia.

Disturbances of dentification during prenatal life will affect only the deciduous teeth.

Chronologically, the development of dental defects occurs very largely in the postnatal period. The great majority of dental abnormalities are confined to the permanent teeth and, in large part, are found in those dental structures formed during the first two or three years after birth, the time at which nutritional de-

ficiency diseases most commonly occur and a period of life during which infections leave a lasting effect on the tissues developing at this time.

Syphilis, notably, may affect either the primary or the secondary dentition. That classical Hutchinson's teeth are now rarely seen is due to institution of modern antisyphilitic therapy during early life, before enamelization of the incisors.

The occurrence of exanthematous diseases either in the mother during gestation or in the child during the years of enamel formation may be registered as definite and permanent defects in the enamel of the teeth. Such defects are located at positions on the crowns of the teeth indicating the extent of enamel formation at the time the disturbance occurred.

CONDITIONS WHICH MAY INFLUENCE TOOTH DEVELOPMENT DURING THE FIRST TWO YEARS OF INFANCY

It is quite evident that the pathologic states with which I am most concerned —those seen in early childhood—have to do with abnormalties related to the deciduous teeth. In later childhood, the permanent teeth become of increasing importance.

There is indeed considerable latitude in the schedule of eruption of the teeth, differences being noted according to sex, race and individual variation. Children who are breast-fed are more precocious in this respect than those who have been raised on prepared foods. In children who have suffered from rickets or from scurvy, the teeth are, as a rule, late in erupting. So also are those in children having a tendency to mental deficiency, imbecility and endocrine deficiency.

The tendency to either delayed or precocious tooth eruption is occasionally noted as a familial inheritance. Many instances have been reported of the presence of teeth at birth. At the present time, I have under my care a premature infant, weighing 4 pounds at birth and now 6 weeks of age, in which the two lower central incisors were present at birth.

As a medical student and in my postgraduate work with Professor Kassowitz in Vienna, I became duly impressed by the information that teething was, under all conditions, to be considered a physiologic process. I have no doubt that some of you are acquainted with the monograph by Kassowitz written to emphasize his beliefs that there was no such thing as the pathology of teething. My impressions were somewhat dispelled by my wife who was always able to predict the eruption of teeth in our older child, who was more or less high strung. In the second child, of different temperament, there was no such evidence of the impending eruption of a tooth.

The process of teething may produce at times a considerable effect on the physical health of the child and a wide range of secondary nervous disturbances. Hemorrhage within the dental sac with secondary infection is a complication of importance. Serious disturbances of the general health are the exception in the normal infant. More serious irregularities may be expected in the malnourished and in those suffering from hereditary syphilis, neuroses, imbecility and other forms of general disease. Many have been the fatal mistakes following an erroneous diagnosis of "teething," the presence of serious infection unrelated to the dental structures being unrecognized.

The eruption of the permanent teeth is, as a rule, not attended by such pronounced disturbances as is the primary dentition even in the same person.

The conditions more commonly affect-

ing tooth development during the first two years of infancy and which predispose to early caries, peridental inflammation and involvement of the neighboring intestinal indigestion, pyelitis, primary and secondary anemia and dysfunction of the endocrine glands, of which cretinism is outstanding.

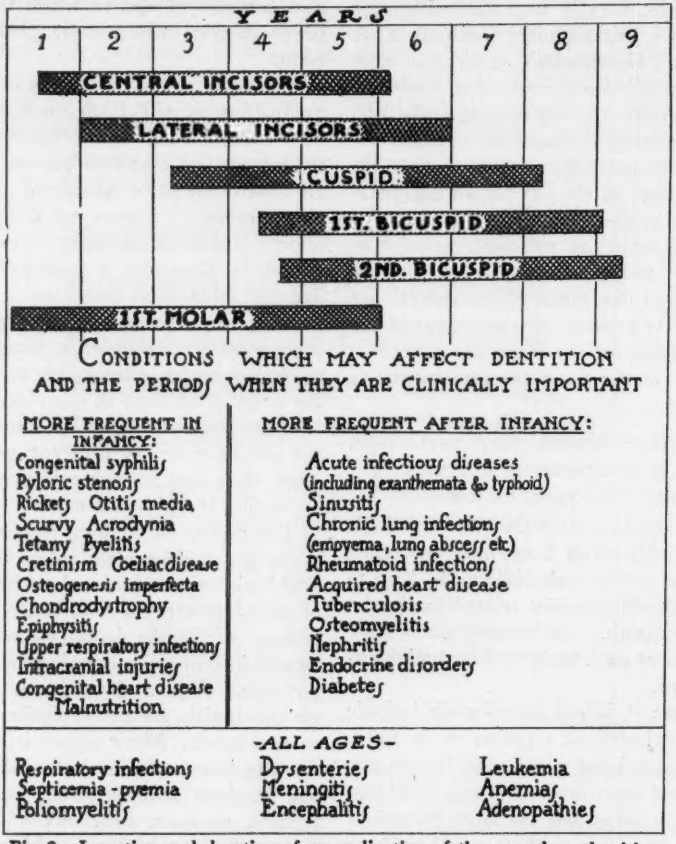


Fig. 2.—Inception and duration of enamelization of the secondary dentition.

structures are acute infections of the new born, birth paralysis secondary to involvement of the central nervous system, malnutrition, rickets, scurvy, pellagra, syphilis, chronic conditions involving the adenoids, tonsils and paranasal sinuses, repeated infections of the respiratory tract, congenital cardiac disease, chronic

CONDITIONS MOST OFTEN AFFECTING TOOTH DEVELOPMENT AFTER INFANCY

Syphilis continues to play its part, as do all other conditions affecting the health in general, with resulting malnutrition and anemia. Severe infections, both acute and chronic, may leave stig-

mata which are evident in the permanent teeth.

ROOT RESORPTION

Root resorption is dependent, in large part at least, on the formation of acids by which the dentin and cementum are decalcified and destroyed. When abscesses occur in the vicinity of the affected organ, the pus which is formed, being alkaline in reaction, may neutralize the acids of the osteoclasts and prevent resorption. Failure of resorption of the root often causes it to act as a foreign body, with resulting prolonged suppuration. You will agree with me that the prolonged retention of such roots tends to deflect the underlying permanent teeth on eruption. Almost invariably in such instances, the crown has also suffered through caries; which leaves little room for argument, from the standpoint of the clinician, for the retention of these foreign bodies. This phase of dental surgery will be given further consideration.

FOCAL INFECTION

The question is frequently asked: What, then, is focal infection? It may be defined as the transportation of infection from one portion of the body to another, with an infection in both places; or, on the other hand, only the toxic products may be responsible for the distant lesions.

Many in the audience will believe, no doubt, that I am emphasizing unduly the importance of focal infections involving the teeth in the young; or, again, there may be differences of opinion as to the frequency of occurrence and the seriousness of secondary lesions. Throughout this discussion, it will be my aim to stress the idea that focal infection has an important relation to our everyday practice. It is equally true that, in the elimination of a suspected focus, disappointment as to the curative effect on distant lesions must be only too frequent. Our prognosis in the individual case must, therefore, be guarded. Such failures are many times attributable to delayed recognition of the relation of the local condition to the systemic involvement, and thereby remedial measures are not instituted sufficiently early.

In a study of focal infection in childhood, it soon becomes evident that the most frequent seats of the primary lesion are the tonsils, sinuses and teeth. The remote effects may exist anywhere or in any of the tissues throughout the body. The distant lesions may be due to the presence of bacteria or their toxic products, transported by way of the blood or lymph stream. Streptococci are the most frequent organisms concerned in focal infection in childhood, although other organisms may be responsible. Among the dental pathologic conditions responsible for focal infection in childhood, periapical infection has, in my experience, been accountable for many and varied conditions, which will be given detailed consideration.

In the discussion to follow, it is assumed that the primary source of infection is related to the teeth and peridental tissues. In reviewing the experiences of a long association with clinics for the care of children, in which the vast majority were patients from the poorer classes, I have formed very definite impressions. It is, of course, self-evident that the peridental infections which I am emphasizing were largely due to infectious processes involving the deciduous teeth.

I shall consider dental infection in its broadest sense; that is, as the end-result of the invasion of infection into the gingival tissues, with pyorrheal involvement of the peridental tissues. In a consideration of oral foci of infection, we must

first appreciate that we are dealing with types of tissues that have no counterpart in other parts of the body, structures with an anatomic relationship definitely their own and, in the young patients of whom I speak, structures normally undergoing retrogressive changes which may be affected and accelerated by a vast number of diseases, many of them peculiar to childhood. While under normal conditions Nature has endowed the teeth with a remarkable protective barrier against localization of infection, nutritional disorders and infections which may at times even be prenatal in their origin may interfere with Nature's best laid plans.

In like manner, the health of the child and his body growth and development may be directly involved by local suppurative processes, whether this be by toxic absorption or by invasion of the blood stream by pathogenic organisms.

I take it that one should feel privileged to speak frankly. Whether it be through lack of desire to do extracting, early educational impressions or fear of systemic reaction following the opening up of fresh atria for absorption in dental tissues, time and time again I have experienced an inexplainable lack of cooperation on the part of the family dentist when suggesting the removal of seemingly offending suppurating deciduous teeth in the presence of pathologic conditions which could be related to the local suppuration. The fact that the early loss of deciduous teeth has been so strongly stressed by the orthodontists as one of the main causes of irregularity of the teeth and jaws is undoubtedly one of the reasons for the attempt of the general practitioner to retain deciduous teeth or roots regardless of their pathologic condition.

While most of the vast literature on this subject deals with adult life, the lessons to be drawn therefrom apply with even greater certainty to the child. While we have, in the decade just passed, experienced a period in which the rush to extract offending and often nonoffending teeth reached a state bordering on hysteria, much has been learned which should be of real value.

The emphasis on preventive dentistry in childhood on the part of your profession during the past ten years is of outstanding importance. There is still too limited a recognition of the advantages to be gained by balanced diet and mouth hygiene during the earliest years of life. The most important periods for preventive work are the prenatal and early infancy, but these do not, as a rule, fall within the scope of the dentist's activities.

The preschool age is the most neglected and, I believe, the most important age from the standpoint of prophylactic dentistry. In many instances in my knowledge, these children have been classed as undesirable patients by the family dentist because of the patience needed to cultivate them into what might be called a good clientele. The school age is the one which has attracted the most attention during recent years, and it is regrettable that dental progress among this group should be credited to demands on the part of the laity. This is the period during which focal infection in the alveolar processes comes in for important consideration and good operative judgment is demanded.

I wish to quote Paul A. Barker at this point, as his conclusions agree fully with the impressions gained by the pediatrician in his clinical practice. He states:

The question of the immediate extraction or the treatment and retention of abscessed deciduous teeth is one which causes almost as much argument and discussion as the same

question regarding permanent teeth. It is my belief, however, that in the majority of cases, abscessed deciduous teeth should be extracted, for any advantage to be gained from maintaining the normal space in the arch by the retention of an abscessed deciduous molar is more than offset by the danger to the child's general health from focal infection, and I have found that in the majority of these cases where the early extraction of a deciduous molar becomes necessary it is a simple matter to maintain the normal, mesiodistal relations of the approximating teeth by the placing of some type of space retainer.

The advice so frequently given by the family dentist that infected and abscessed deciduous teeth should be allowed to remain in the mouth until naturally exfoliated by the eruption of the permanent teeth is, to my mind, evidence of a lack of diagnostic vision. I am certain that no enlightened dentist advises an adult to retain a badly abscessed first molar merely because the loss of the first molar will cause the second molar and bicuspid to tip and imperil the balance of normal occlusion. He will, I am sure, in every instance consider the general health of the patient, and unless he believes himself fully justified in retaining the offending tooth, he will order extraction. How much more justification there must therefore be in extraction of an abscessed deciduous tooth whose roots have largely undergone resorption and whose crown is partially destroyed through caries, leaving but little of the original supporting framework.

Our knowledge of focal infection in the adult should be applied to the child, whether it relates to tonsils, sinuses, teeth or other tissues. General health is of the greatest importance, and if deciduous teeth become infected and cannot be put in healthy condition, they should be extracted. In addition to the effect on the neighboring structures, one often sees marked systemic reaction to an alveolar abscess in the young child, as evidenced by headache, nausea, vomiting and fever.

It is to be remembered that the child, because of its lack of years, has not had full opportunity to build up an immunity of a degree to be noted in older persons. One of the most striking evidences of this is noted in the blood picture in such children, who often show rapidly developing anemia with an insignificant leukocytic reaction.

Certain facts gleaned from the literature and personal experience are outstanding.

1. Recoveries from systemic conditions, especially those having to do with the circulatory and nervous systems, in children frequently follow good dental surgery, the removal of tonsils and adenoids or the reestablishment of accessory sinus drainage.

2. Failure to experience the awaited response can by no means always be interpreted as mistaken diagnosis. Distant localization through neglect may offer the explanation.

3. The occasionally experienced severe exacerbations following extractions may be viewed in the light of corroborative evidence as to the seat of at least one offending source.

4. The recovery of streptococci and other organisms with like morphologic and cultural characteristics from distant tissues, such as glands, joints, the pericardium and pleura, is, to say the least, suggestive.

Let us now review the possible conditions which may be etiologically related to foci of infection originating in the dental tissues. First, the pain and discomfort of mastication may lead to malnutrition. By direct extension, acute glandular suppuration or subacute forms of adenitis are the most common complications of peridental tissue disease. In older

children, occasionally one sees maxillary sinusitis. Such recurrent foci not infrequently lead to reactivation of distant quiescent pathologic conditions, or, on the other hand, fresh lesions in sensitized tissues through the passage of the organisms into circulatory channels. Further systemic effects may follow in the wake of a lowered body defense mechanism even though there is no specific infective localization. Unquestionably, such a fact may be important in the reaction of the child's tissues to the many infections and contagions of early childhood.

Among the more important systemic pathologic states which may be related to peridental suppuration are malnutrition, anemia, rheumatic fever, arthritis, myositis, fibrositis, erythema, purpura, neuroses, chorea, hyperthyroidism, carditis (endocarditis, myocarditis and pericarditis), embolic pneumonia, lung abscess, pleuritis and empyema, pyelitis, pyelonephritis, septicemia and pyemia, osteomyelitis, meningitis and encephalitis, and many others might be mentioned. While fortunately most of these conditions are more than rare as far as their origin can be traced to dental infection, I have seen cases of most of them in my own experience in which the evidence was strongly suggestive. Among those more outstanding are the anemias, rheumatic fever, myositis, chorea, carditis and pyelitis.

In the past year, I have seen two cases of acute thyroiditis of the nonsuppurative type in which extraction was followed by prompt recovery. In the March issue of the *Medical Clinics of North America,* I reported a case of thrombocytopenic purpura in which an acute exacerbation was experienced after the removal of a badly infected deciduous tooth. Two of my friends were cured of maxillary sinusitis—one of three years' and the other of fourteen years' standing—after the removal of a tooth with a root abscess that had invaded the sinuses.

We will all concede that peridental infection is much more significant in children who are in poor health than in those who are well. Then let us go farther and visualize the possibilities of the acute contagious diseases and the seasonal infections in the under par young.

I wish at this time to lay special emphasis on the danger due to the aspiration of loose deciduous teeth and roots during the administration of an anesthetic for operative procedures, and this applies more especially to tonsillectomies.

In closing, I am far from desiring to leave the impression that peridental infection is the etiologic factor in any great percentage of the total pathologic states seen in and experienced by children. They are of sufficient importance and of such common occurrence that they should always be given the important consideration which they warrant in the final evaluation of diagnosis of disease and its treatment in childhood.

104 South Michigan Avenue.

EXPERIMENTAL STUDY OF THE INFLUENCE OF VITAMIN D ON THE HARD TISSUES OF WHITE RATS*

By RUDOLF KRONFELD, M.D., and F. J. BARKER, D.D.S., Chicago, Ill.

A GREAT number of experiments and studies have been made concerning the relation between tooth structure and diet. These experiments can be divided into two groups: (1) clinical observations, including experiments on children, and (2) experimental work on animals. Among the large number of publications dealing with this problem, we shall mention only the more recent publications that have a bearing on our own experiments; namely, the experimental tissue changes produced by variations of the vitamin D content in the diet. From these investigations, we know how the developing teeth of different animals, such as rats, guinea-pigs, dogs, pigs, and monkeys, react to different changes and deficiencies in diet. Some authors have reported on the occurrence of decay in the teeth of such animals. It is not decided whether this experimental caries was due to defects in the tooth structure caused by diet, or to the physical and chemical properties of the food (sticky carbohydrates), or both.

A large number of these experiments dealt with the influence of vitamins on the animals. In most of the experiments in which vitamins were administered, other components of the diet were varied too. It is our opinion that, in experiments of this type, the arrangement should be as simple as possible. It seems inadvisable to introduce more than one "unknown" component. In too complicated experiments, the experimenter is often unable to determine which condition is responsible for the results obtained. Therefore, we decided to work with only one well-determined vitamin preparation, to try to discover its influence on the tissue of white rats otherwise fed on a diet of simple and well-known composition. During these experiments, we kept the animals in a uniform and constant environment, and thus the presence or lack of this particular vitamin became responsible for all observed changes.

The vitamin D preparation used was viosterol, irradiated ergosterol which is standardized and is supposed to be constant as to reaction and composition. For investigating the biologic action of this vitamin, we used white rats. The stock rats were fed on a diet sufficient in salts and vitamins. In addition, they received fresh butter, lettuce and raw meat. Only animals from the same litter were used in the various experiments, there being usually from six to twelve rats in each litter. Of these, two were kept for controls, and the others, after reaching a weight of approximately 60 gm., were placed in separate cages on different diets. Two diets were used. One consisted of

*Read at the Annual Meeting of the International Association for Dental Research in Toronto, March 26, 1930.

*From the Research Department of the Chicago College of Dental Surgery, Dental Department of Loyola University.

three parts polished rice and one part powdered calcium carbonate. This diet is deficient in important food elements as well as being entirely devoid of vitamins. Rats cannot live on this diet longer than five or six weeks. The other diet used was McCollum's ricket-producing diet 3143, consisting of:

Whole wheat meal, 33 per cent; yellow maize meal, 33 per cent; wheat gluten, 15 per cent; gelatin powder, 15 per cent; calcium carbonate, 3 per cent; sodium chlorid, 1 per cent.

In addition to both these diets, vitamin D (viosterol) was given in two ways: Some groups received it together with the deficient diet to determine whether or

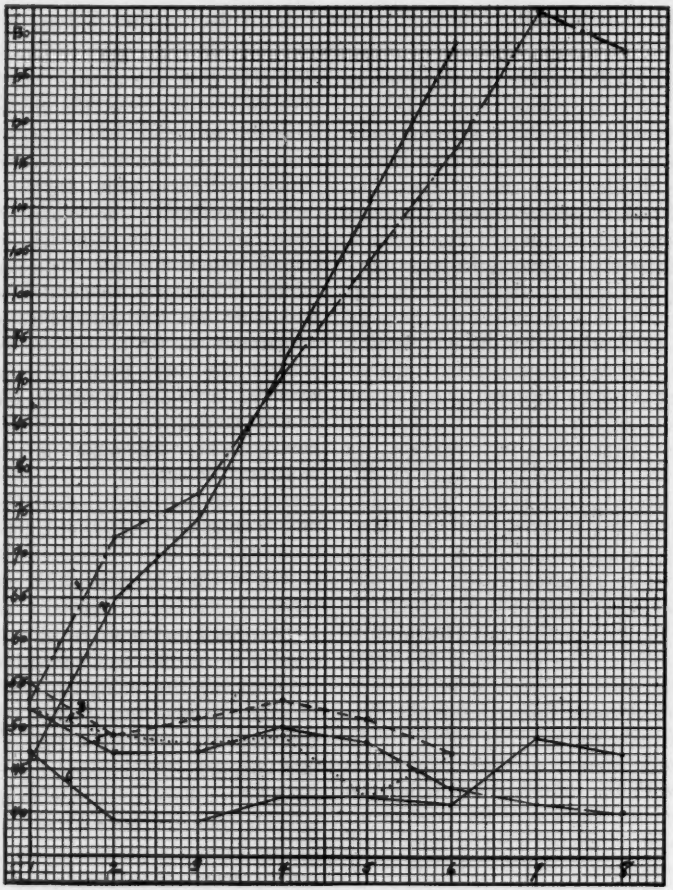


Fig. 1.—Weights of six animals in Experiment 1. *1* and *2*, control animals; *3* and *5*, animals on calcium carbonate, rice and viosterol; *4* and *6*, animals on rice and calcium carbonate. The figures at the left give weights; at the bottom, number of weeks.

not pathologic changes could be prevented by administration of the vitamin; whereas, other groups were first placed on the deficient diet for several weeks, and only after certain pathologic changes had occurred were they given viosterol, to determine whether these changes could be overcome and a normal condition restored.

Each rat was weighed every week. At the same time, roentgenograms were taken of the entire body by placing the animal under slight ether narcosis, on a 5 by 7 inch film. These pictures gave valuable information about the calcification and growth of the long bones that could otherwise have been secured only by necropsy. (Figs. 6-8.)

After the experiments had been carried on for a period of from six to ten weeks, the rats were killed and the tissues fixed in formalin. The hard tissues were decalcified in 5 per cent nitric acid, embedded in celloidin and cut in serial sections.

From each rat, there was kept for histologic investigation the upper and lower incisors and molars, knees, ribs, sternum and inner organs. The comparison between teeth and bones proved to be very interesting, as we found differences in the localization of the changes. In some, the pathologic changes in the teeth were

Fig. 2.—Control animal at the end of experiment. The condition of the knees and of the vertebrae of the tail are of interest.

Fig. 3.—Rat from the same litter as the control animal (2) that was kept on a diet of rice and calcium carbonate for eight weeks. There are deformities of the tibia and femur at the knee and poor development and delayed calcification of the vertebrae of the tail.

very marked; whereas, the bones showed only minor disturbances. In others, the bones, especially the ends of the long bones of the extremities, showed symptoms of severe rickets both clinically and histologically, but the teeth were almost normal. These findings correspond to the clinical observation of some rachitic children with comparatively few bone changes but whose teeth show very poor development. In other children, the teeth are almost normal; whereas, the skeleton gives evidence of severe rickets.

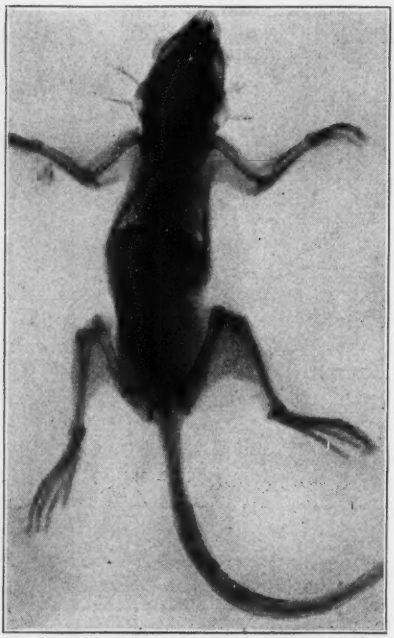


Fig. 4.—Rat that was fed rice and calcium carbonate for 8 weeks, the last five weeks being given one drop of viosterol a week additional. Better formation of the long bones and better development and calcification of the vertebrae of the tail can be seen.

The rats' inner organs were kept in order to check the possible toxic action of the viosterol. We considered this necessary because of the reports of clinicians and experimenters concerning the dangers of overdosage of vitamin D. The kidneys of each animal were sectioned, but no pathologic changes were found in them.

PHYSIOLOGIC OBSERVATIONS MADE ON THE ANIMALS

Experiment 1.—The first experiment was made on six rats of the same litter. When the animals had reached a weight of about 50 gm., two were separated from the others and kept on a normal diet as control animals. (Fig. 1, animals 1 and 2.) These showed a rapid and regular increase in weight during the following weeks. The other four animals were placed on a diet consisting of three parts polished rice and one part powdered calcium carbonate, and, in the first week, showed a sudden loss in weight, after which they maintained an almost constant weight for from six to eight weeks. (Fig. 1, animals 3, 4, 5 and 6.) At the beginning of the third week, two of the animals (3 and 5) were separated from the others and given viosterol, one-seventh drop a day (1 drop a week). This amount was reckoned thus: The maximum curative dose suggested for man is 30 drops a day. Reducing this amount according to the body weight of an average young rat, gave one-seventh drop a day or 1 drop a week. Rat 3 got this amount of viosterol for three weeks and was then killed. During the six weeks of experimentation, its weight had decreased from 55 to 47 gm. At the same time, the control (2) was killed, as well as animal 4, which had been fed three parts rice and one part powdered calcium carbonate plus the vitamin. (Fig. 1, *1*, six weeks line.) Animal 5 received one-seventh drop of viosterol a day for two

more weeks, then was killed, together with rat 6, which received no vitamin, and the control animal, 1.

There is no considerable difference in weight between the animals which received viosterol and those that did not. The slight variations in weight in either direction that are seen in the graph (Fig.

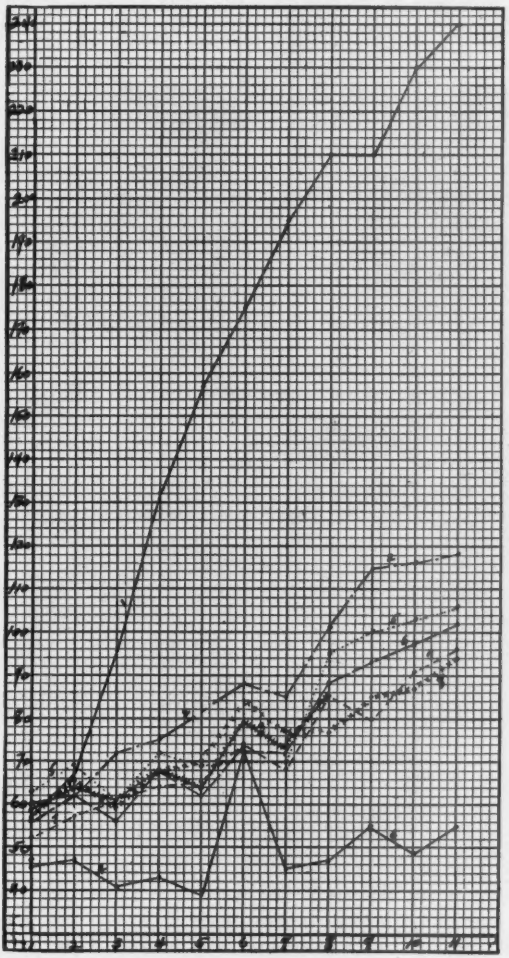


Fig. 5.—Weights of eight animals in Experiment 2. *1*, control animal; *2*, *3* and *4*, animals on McCollum's rickets producing diet 3143; *5* and *6*, on McCollum's rickets producing diet and one drop of viosterol a week; *7* and *8*, on McCollum's rickets producing diet 3143 and one drop of viosterol a day.

1) in animals 3, 4, 5 and 6 are within the range of normal deviation, and therefore cannot be used for drawing conclusions.

There was a difference in the clinical aspect and behavior of these animals. The ones fed on only rice and calcium showed, after the second or third week, very poor general conditions. They could hardly walk and their fur was mangy, the hairs standing erect and being very irregular. The two animals that received

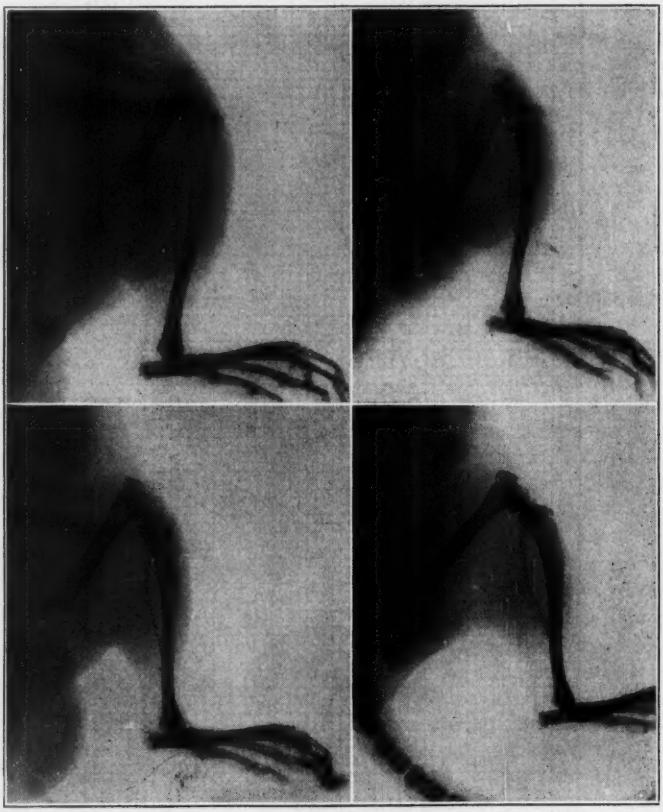


Fig. 6.—Right legs of five animals in Experiment 2. Above: Left, control animal. The appearance of the femur and tibia at the knee is of interest. Right, rat of the same litter kept on diet 3143 for 10 weeks. The junction between epiphysis and diaphysis of the tibia is imperfect, they appearing separated by a wide area of uncalcified tissue. Below: Left, rat fed on diet 3143 for 10 weeks and one drop of viosterol a week. Right, rat fed on diet 3143 for ten weeks and one drop of viosterol a day. There is a complete bony junction between the epiphysis and diaphysis of the tibia.

viosterol had a much better appearance. They moved about normally and their fur looked natural.

A remarkable difference could be seen in comparing the roentgenograms of these experiments. Figure 2 shows the control animal (1, Fig. 1) whose weight during the eight weeks of the experiment increased from 53 to 128 gm. Figure 3 shows a rat of the same litter that was kept on rice and calcium for eight weeks. Its weight remained constant throughout this time, 47 gm. Severe changes in the bones of this animal became evident by a comparison of it with the control, 2. The distal end of the femur and the proximal end of the tibia are swollen, and there is a widened irregular radiolucent zone between epiphysis and shaft. Rat 5 from Experiment 1 is shown in Figure 4. This rat received one-seventh drop of viosterol a day for six weeks, and its weight decreased from 52 to 40 gm. during this time. In spite of the fact that it weighed less than the one that did not get viosterol (6), the bone system showed better conditions. In configuration, the knees show more normal conditions, and a comparison of the vertebrae of the two tails reveals much better calcification in the one of the rat that received viosterol. This difference in calci-

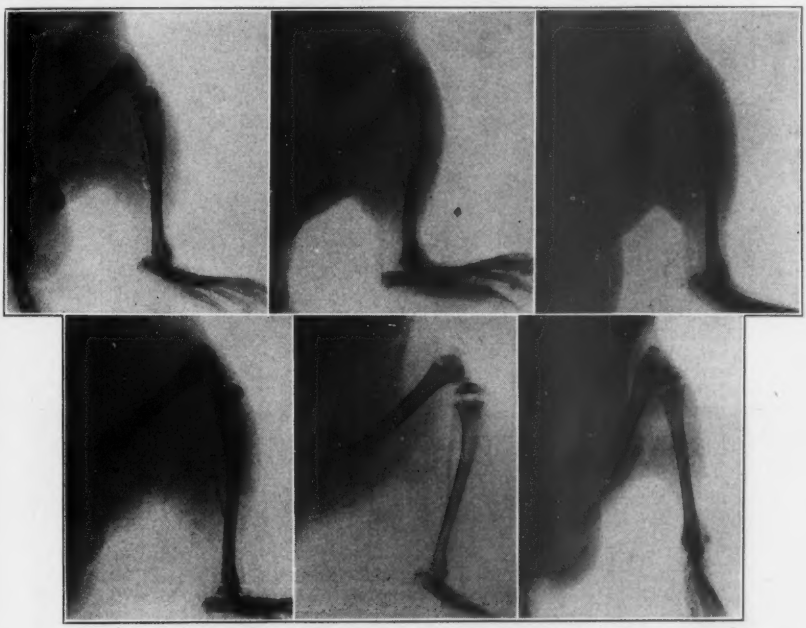


Fig. 7.—Right legs of animals in Experiment 3 (see also Figure 8). Above: Left, appearance at beginning of experiment. Center and right, appearance, respectively, of control animal and animal on McCollum's rickets producing diet 3143, after one week. Below: Appearance, after two weeks, of (left) control animal and (center and right) animals on diet 3143. There is a wide uncalcified area between the epiphysis and the diaphysis of the tibia.

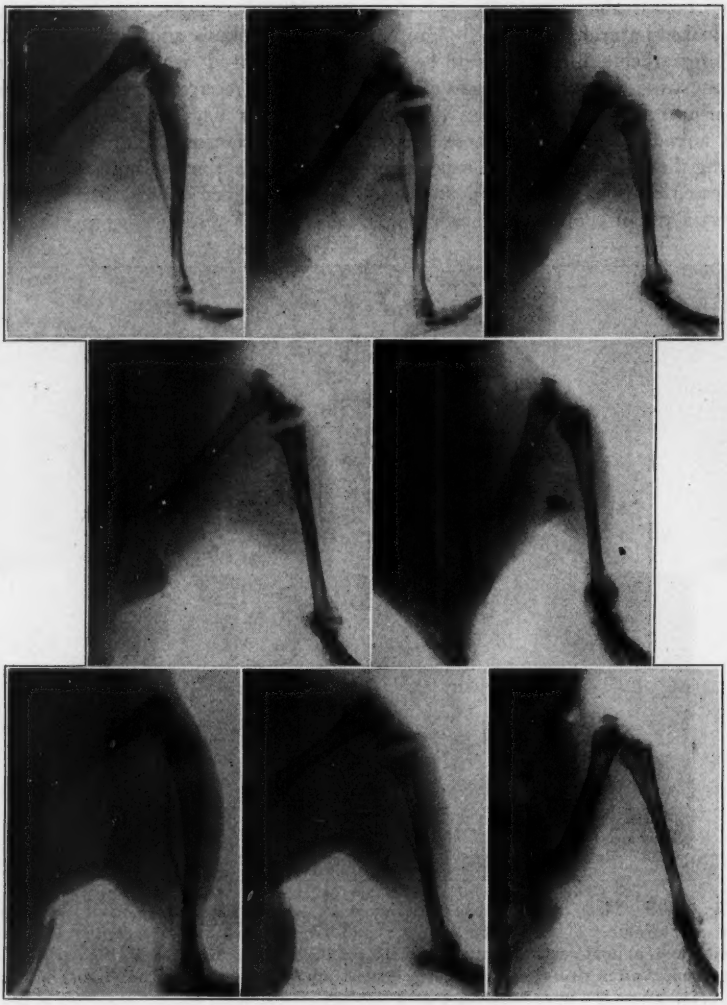


Fig. 8.—Right legs of animals in Experiment 3 (see also Figure 7). Above: Appearance of animals after three weeks: left, control animal; center, animal on diet 3143; right, animal on diet 3143 plus 3 drops of viosterol a day for one week. Center: Appearance of animals after four weeks: left, animal on diet 3143; right, animal on diet 3143 plus 3 drops of viosterol a day for two weeks. Below: Appearance of animals after five weeks: left, control; center, animal on diet 3143; right, animal on diet 3143 plus 3 drops of viosterol a day for three weeks.

fication will be more evident in the study of the histologic slides.

These findings regarding the weights are characteristic of the entire experiment. It was always found that the administration of vitamin D had no or very little influence on the body growth or with normally calcified skeletal systems.

Experiment 2.—The remainder of the experiments were based on the changes produced in the bodies of the rats by McCollum's rickets producing diet 3143. The arrangement of Experiment 2 was the same as for Experiment 1. A group

Fig. 9.—Distal end of femur of control animal in Experiment 1. (Compare Figure 2, normal structure of the bone.) *S*, shaft of the femur (diaphysis); *C*, cartilage; *E*, epiphysis; *P*, patella; *M*, muscles.

weight, but that it did affect the calcification greatly. An insufficient diet combined with a certain dose of vitamin D tends toward the development of dwarf animals of eight rats from the same litter, weighing from 45 to 60 gm., were used. One animal was kept on a normal standard diet as a control, and three others were

fed on diet 3143 for ten weeks. Two received one drop of viosterol a week in addition to diet 3143. Two others were given one drop of viosterol a day. This latter group was added in order to see the effects of administration of a larger amount of viosterol, as one drop a day for a rat exceeds by far the corresponding dose for man.

The weights of these animals can be seen in Figure 5. The weight of the control animal (1) shows a steady increase from 58 to 240 gm. in ten weeks. The animals 2, 3, 4, which were fed on a rickets producing diet with no vitamin D, show an irregular curve of weight with little gain. Rat 4, which was the smallest in the litter, shows the least gain, increasing from 42 to 53 gm. The animals 5-8, which received viosterol in addition to diet 3143, show curves that

Fig. 10.—Distal end of femur of rat fed on rice and calcium carbonate for eight weeks. There is pathologic thickening of the shaft, *S*, in its distal portion. *M*, metaphysis (rachitic area between shaft and epiphysis); *C*, cartilage; *C'*, irregular islands of cartilage in rachitic metaphysis. The light shade of the bone is due to the presence of osteoid (uncalcified bone).

Fig. 11.—Distal end of femur of rat fed on rice and calcium carbonate plus one drop of viosterol a week for five weeks. There is slightly better configuration of the shaft. The darker color of the bone indicates its better calcification. The rachitic metaphysis is less distinct.

do not vary a great deal from those of the animals not receiving vitamin D. They weighed from 51 to 62 gm. at the beginning, and reached a weight of from 94 to 106 gm. after ten weeks. There is no considerable difference in weights between the animals fed on diet 3143 only and those on this diet plus vitamin D.

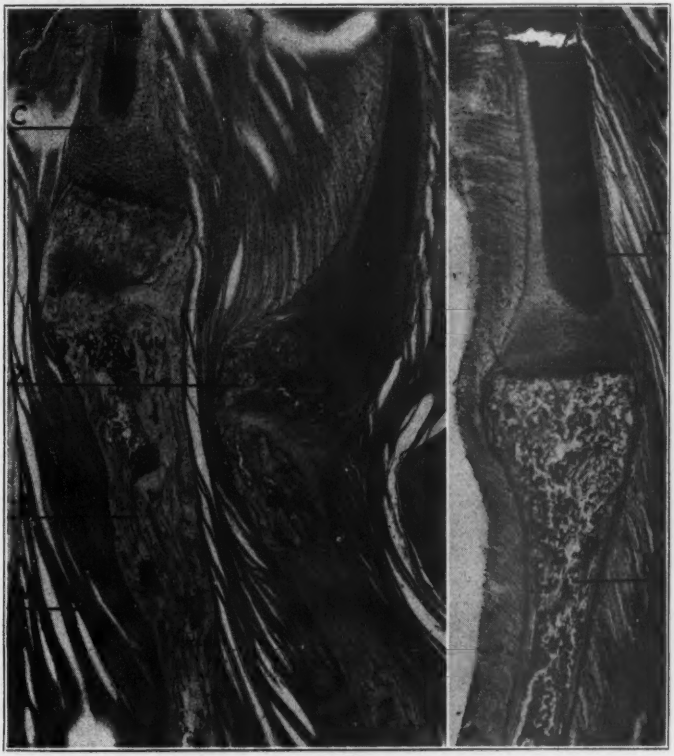


Fig. 12.—Left, two ribs of animal shown in Figures 3 and 10. *C*, cartilage of rib; *B*, bone; *M*, intercostal muscles; *X*, swelling and distortion of bone and cartilage analogous to "rachitic rosary" in human beings. The bone is very light due to the presence of osteoid. Right, rib of animal illustrated in Figures 4 and 11 (one drop of viosterol a week for five weeks). Better calcification of the bone and almost normal configuration of the junction between cartilage, *C*, and bone, *B*, are evident.

The roentgenograms obtained in these experiments reveal the remarkable influence of the viosterol on the development and calcification of the bones. We wish to show only the knees of four of these eight animals, taken one week before the end of the experiment. (Fig. 6.) *A* is the knee of the control animal. The epiphysis and diaphysis of the tibia are almost joined, only a small translucent area still being present. *B* is the knee of one of the same litter that was kept on the rickets producing diet for ten weeks. Here, the imperfect calcification is espe-

cially evident. Epiphysis and diaphysis of the tibia are separated by a wide uncalcified area. *C* is the knee of another that received diet 3143 for ten weeks and in addition one drop of viosterol a week. The bones are slightly smaller than those of the control animal *A*. Otherwise, there is little difference in the calcification between *A* and *C*. As far as can be seen in the roentgenogram, the vitamin D has compensated for the insufficiency of the diet.

control animals were kept were certainly not ideal. Though these animals received a sufficient diet and looked normal and healthy, they lacked fresh air and sunlight. Therefore, by giving a large amount of viosterol, we were able to produce a better condition of the bones than that found in the control animals.

Experiment 3.—In this experiment, the arrangement was changed so as first to produce severe changes in the body of the rat by a complete deficiency of vita-

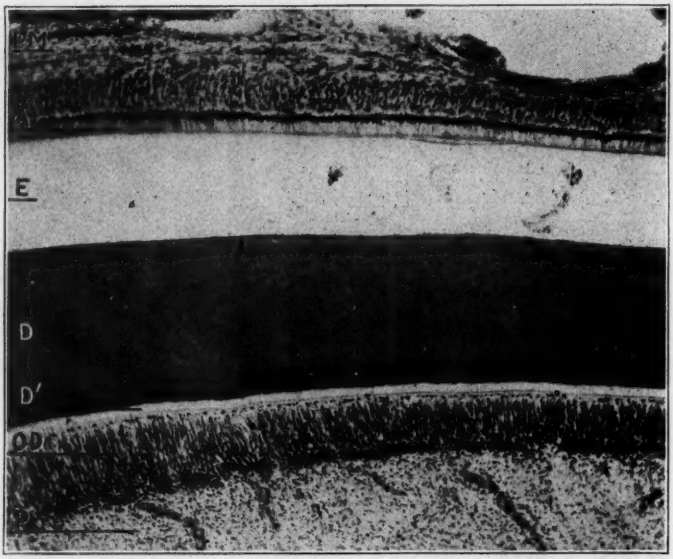


Fig. 13.—Labial side of upper incisor of control animal in Experiment 1. *P*, pulp; *OD*, odontoblasts; *D'*, dentinoid; *D*, dentin; *E*, space formerly occupied by enamel; *A*, ameloblasts; *PM*, periodontal membrane.

D shows the knee of the rat that received one drop of viosterol a day in addition to diet 3143. Here, the junction of epiphysis and diaphysis is complete. Calcification seems to be slightly better than in the control animal. The latter fact may be explained by considering that the conditions under which our

min D, and then, by adding viosterol, to check these changes. This experiment was carried out in the following manner: three groups of rats from the same litter, of an average weight of 90 gm., were used. One was kept on a normal diet, with additional raw meat, butter and green leaves, and the others were

placed on McCollum's rickets producing diet 3143. Roentgenograms and weights were tabulated weekly. After four weeks, one rat which had been kept on McCollum's diet was killed and sectioned to determine the changes that had occurred up to this time. The remaining rats were separated into two groups. One was kept on a plain rickets producing diet, and the other received in addition three drops of viosterol. This arrangement was continued for three weeks, when all animals were killed and sectioned.

Figure 7 illustrates the changes that were found in the knees by means of roentgenograms taken throughout the progress of the experiment. Figure 7, above, left, shows the condition typical of all the animals at the beginning of the experiment. At this age, there was not as yet a bony junction between the shaft (diaphysis) and the ends (epiphyses) of the long bones, tibia and femur. Therefore, the roentgenogram shows a radiolucent area between epiphysis and diaphysis.

The views in Figure 7, above, center and right, were taken three weeks later. The roentgenogram in the center shows the control animal. The light area between epiphysis and diaphysis has been reduced by the progressive calcification of the cartilage. On the right is the knee of an animal kept on McCollum's rickets producing diet for the three weeks. The uncalcified area is wider than in the film on the left and the shape of the bone ends shows a deviation from the normal.

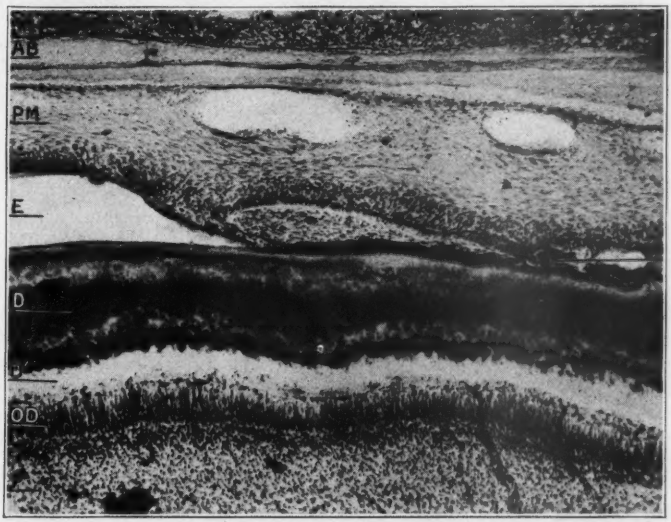


Fig. 14.—Corresponding area from rat shown in Figures 3, 10 and 12, left. *P*, pulp; *OD*, odontoblasts; *D'*, dentinoid; *D*, dentin; *E*, space formerly occupied by the enamel; *PM*, periodontal membrane; *AB*, alveolar bone. At *X*, the enamel formation has been entirely interrupted. The dentin is poorly calcified. The dentinoid is wide and shows a wavy course.

The views in Figure 7, below, were taken a week later. On the left is the knee of the control animal in which epiphysis and diaphysis are almost united. In the center is one of the animals kept on McCollum's diet. The space between epiphysis and diaphysis has become considerably wider, which indicates the presence of a disturbance of the calcification. This animal was killed at this time. Figure 7, right, shows the knee of an-

ing. On the right is the knee of the animal which received viosterol for one week. After this relatively short period, there is already a marked difference between the calcification in this animal and in the one at the right, below, in Figure 7. In addition, it should be mentioned that this animal was, at the time the latter was taken, in such poor condition that we thought it would die within the next few hours. It was lying in the

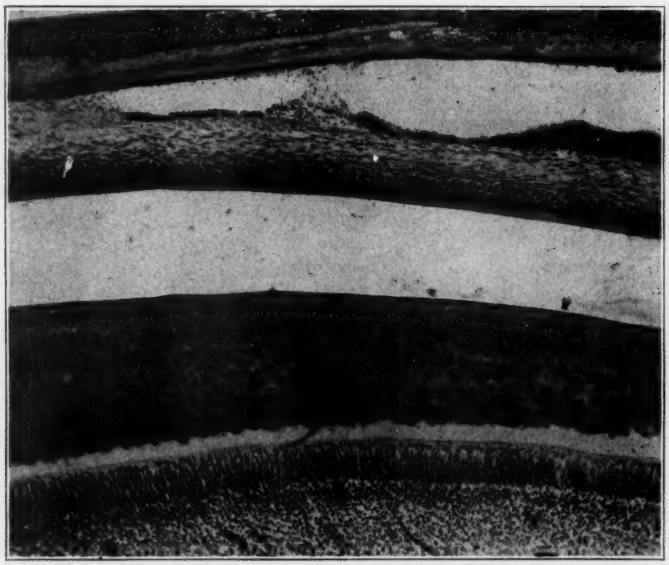


Fig. 15.—Corresponding area from rat shown in Figures 4, 11 and 12, right. The outline of the enamel is normal. The dentin is much better calcified and the dentinoid narrower than in Figure 14.

other rachitic animal. After this picture was taken, the animal received one drop of viosterol a day.

The views in Figure 8, above, were taken a week later. The difference between calcification in the roentgenogram at the left (control animal) and that at the center (McCollum's diet) is strik-

cage unable to crawl and was breathing fast and heavily. We administered viosterol with a dropper directly into its mouth. A week later, this animal had recovered and acted normally.

The two views shown in the center, which were taken the following week, show a great difference in the calcifica-

tion between the animal on McCollum's plain diet (left) and the one (right) which received one drop of viosterol a day in addition to the McCollum's diet.

The last series of roentgenograms (Fig. 8, below) was taken at the end of this experiment. The control animal (left) shows the bony junction between epiphysis and diaphysis to be almost complete. The one in the center was taken from the animal on McCollum's diet which roentgenographically, as well as histologically, showed severe rickets. The one on the right is from the animal shown in Figure 7, below, right, and Figure 8, above, right. As the result of the administration of large doses of viosterol, the bony junction has become complete, and there is no more evidence of the former severe nutritional disturbances in the roentgenogram except that the animal is slightly smaller than the control animal.

HISTOLOGIC FINDINGS

As these experiments involved fifty-five animals, it is not possible to reproduce the findings in more than a small percentage of them. Fortunately, these are sufficient, as the histologic changes were uniform in all the animals of each group. It is our intention to show sections made not only from teeth but also from other hard substances of the body, such as the femur and ribs.

Experiment 1.—The following pictures are taken from sections through the distal end of the femur of three animals from Experiment 1. The roentgenograms of these three rats were reproduced in Figures 2, 3, 4. Figure 9 shows a section through the femur of the control animal. (Fig. 2.) The shaft gradually thickens toward the head, and the epiphysis is inserted with a narrow regular border of cartilage.

Figure 10 shows the femur of the rat

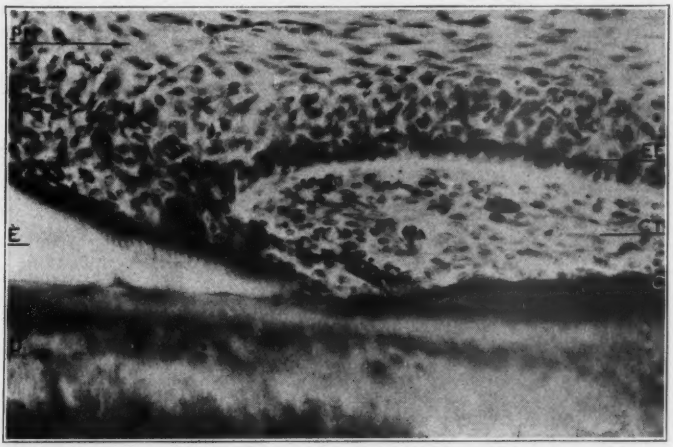


Fig. 16.—Area near *X* from Figure 14. The enamel epithelium, *EE*, has become separated from the surface of the dentin, *D*. The space between the enamel epithelium and the dentin, *D*, has become filled with connective tissue, *CT*. *EE*, enamel epithelium; *C*, deposits of cement-like substance on the dentin; *E*, enamel; *PM*, periodontal membrane.

shown in Figure 3. The bone gives evidence of severe disturbances in outline as well as in structure. In the normal animal (Fig. 9), the head of the femur is much thicker than the shaft. In Figure 10, the shaft shows a heavy swelling immediately beneath the cartilage, a deformity of the joint resulting that is characteristic of rickets (rachitic metaphysis). The formation of bone is disturbed as indicated by the presence of atypical areas of cartilage in the shaft.

week for six weeks. In spite of this small amount of vitamin D, the bony structure of the femur shows some improvement as compared to the condition shown in Figure 10, and the swelling of the shaft is not so extensive. The cartilage between epiphysis and diaphysis is narrower, and there are no isolated areas of cartilage. The bone trabeculi are more normal and do not have the light color that is characteristic of osteoid.

Figure 12 illustrates the condition of

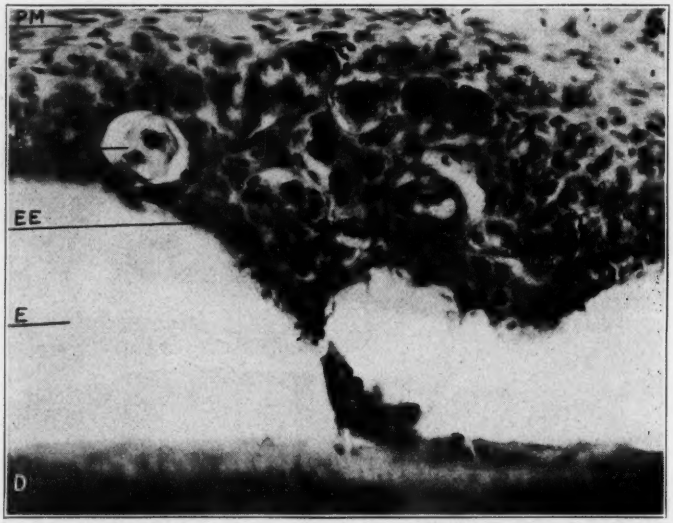


Fig. 17.—Hypoplasia in enamel of tooth. *D*, dentin; *E*, enamel; *EE*, irregular proliferation of enamel epithelium causing formation of small droplets of enamel, *E'*; *T*, soft tissue at bottom of hypoplasia on surface of dentin; *PM*, periodontal membrane.

The bone itself appears very light in the picture because of the presence of uncalcified bone (osteoid). The compact bone of the shaft itself is much thinner than in Figure 9.

Figure 11 is the femur of the animal shown in Figure 4. This rat received the same diet as the preceding animal and in addition one drop of viosterol a

the ribs of two of these animals. Both were fed on a rice and calcium diet for eight weeks. One received one drop of viosterol a week for five weeks. On the left are the two ribs of the animal on a plain rice and calcium diet. The bone is for the most part uncalcified. In one of these ribs, the cartilage has been pulled away from the soft poorly calcified bone

Fig. 18.—Four root ends of lower molars of different animals from Experiment 2. Above: Left, control animal. *P*, pulp; *D*, dentin; *C*, cementum; *PM*, periodontal membrane; *AB*, alveolar bone. Right, animal on McCollum's rickets producing diet 3143 for eleven weeks. *P*, pulp; *D'*, dentinoid lining pulp canal; *C'*, cementoid at apex; *PM*, periodontal membrane; *AB*, alveolar bone with light layers of dentinoid. Below: Left, animal on diet 3143 plus one drop of viosterol a week for eleven weeks. No cementoid is seen at the apex. The hard tissues appear normal except for a slightly enlarged layer of dentinoid. Right, animal on diet 3143 plus one drop of viosterol a day for eleven weeks. Normal calcification of the hard tissues.

by the muscular action of the chest. The bone and cartilage join at an angle causing a bulging of the anterior wall of the thorax ("rachitic rosary").

The rib of the animal that received vitamin D (right), presents a much better condition. The calcification and shape of the bone are almost normal. The cartilage and bone join in a straight line.

The following pictures illustrate the changes in the dental structures of these rats. Corresponding areas from the labial curvature of the upper incisors were photographed. The rat's incisors are excellent indicators of dental changes, as

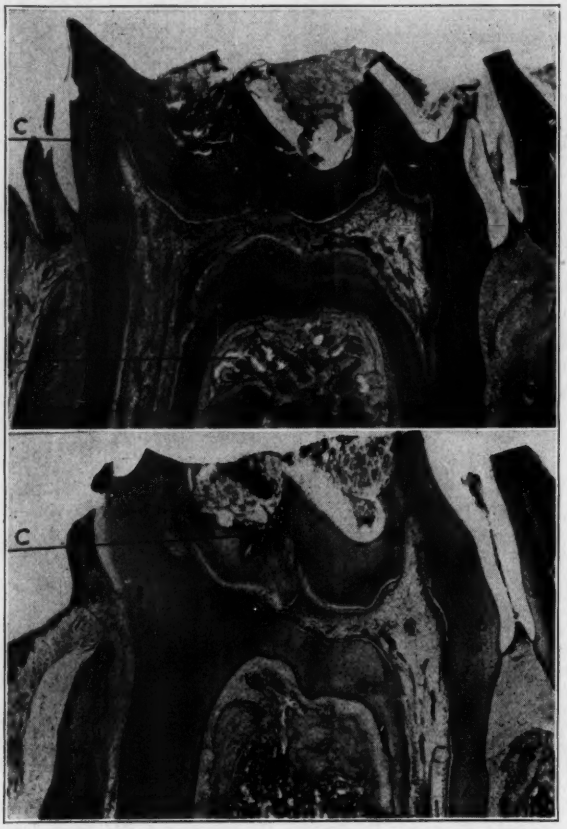


Fig. 19.—Two lower molars both showing caries of enamel and dentin in corresponding areas. Above, lower first molar of rat on diet 3143 for eleven weeks. *C*, caries; *O'*, layers of osteoid bordering rachitic bone. Below, animal on diet 3143 plus one drop of viosterol a day for eleven weeks. *C*, caries. There is normal structure and calcification of the alveolar bone.

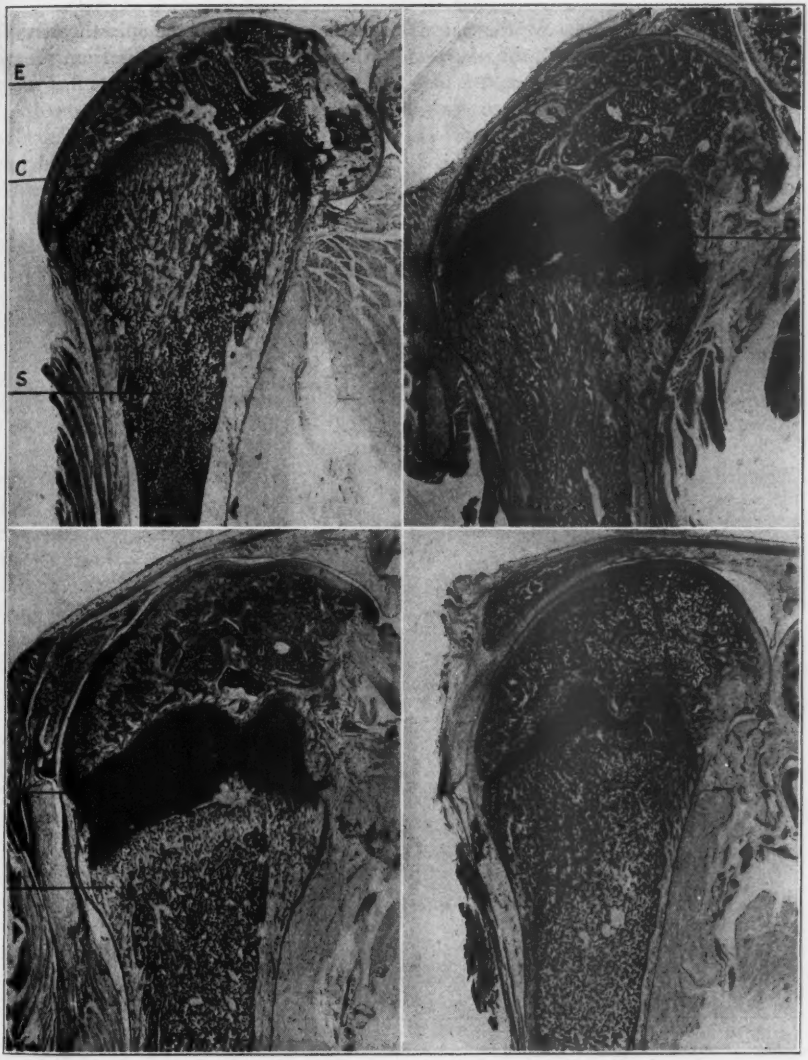


Fig. 20.—Four femurs of different animals of Experiment 3. Above: Left, control animal. *S*, shaft of femur (diaphysis); *E*, epiphysis; *C*, narrow layer of cartilage at junction of diaphysis and epiphysis. Right, animal on diet 3143 for five weeks. *C*, enlarged layer of cartilage of junction of diaphysis and epiphysis. Below: Left, animal on diet 3143 for eight weeks. There are severe rachitic changes. *C*, cartilage; *M*, swelling of distal part of shaft (metaphysis). Right, animal on plain diet 3143 for five weeks, then additional 3 drops of viosterol a day for three weeks. The outer contour of bone is normal. There is a narrow layer of cartilage between the epiphysis and the diaphysis. The shaft is as a whole frailer than in the control animal (Fig. 20, above, left).

they grow continuously. At the apical end, there is a continuous formation of new tooth substance; whereas, the occlusal end is continuously worn away by mastication. The weekly rate of growth of these incisors is between 2 and 3 mm., depending on the general condition and size of the animal. As the entire length of an incisor is from about 12 to 15 mm., it is evident that the entire tooth is practically regenerated or rebuilt in from four to six weeks. If changes in these teeth are produced by sudden alterations in the diet, they will

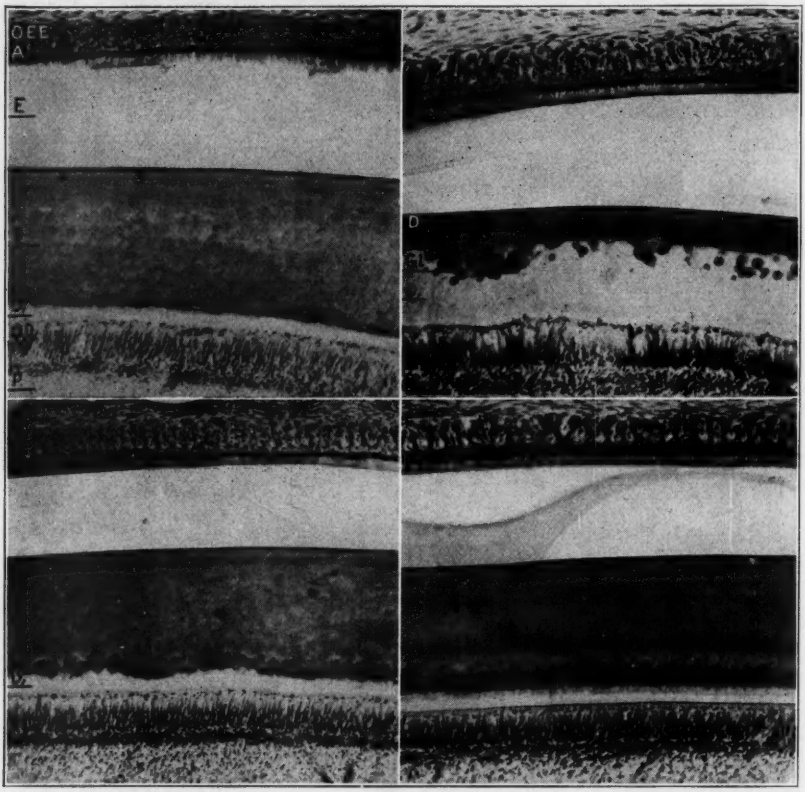


Fig. 21.—Four upper incisors of different animals of experiment 3; corresponding to the same animals as in Figure 20. Left: Above, control animal. *P,* pulp; *OD,* odontoblasts; *D′,* dentinoid; *D,* dentin; *E,* space formerly occupied by enamel; *A,* ameloblasts; *OEE,* outer enamel epithelium. Below, animal on diet 3143 for five weeks. The dentinoid, *D′,* is slightly enlarged. The dentin shows numerous interglobular spaces. Right: Above, animal on diet 3143 for eight weeks. There are severe rachitic changes of the dentin; *D′,* very wide dentinoid; *GL,* globuli of calcification; *D,* dentin. Below, animal on plain diet 3143 for five weeks, then 3 drops of viosterol a day for 3 weeks. There is almost normal calcification of the dentin.

be noticeable first in the apical part; usually, after about six weeks, the entire tooth is more or less involved.

A poor calcification of the rats' incisors first becomes evident in the dentin. A widening and irregularity of the dentinoid, and an abundance of interglobular spaces in the dentin, are the results. If the disturbance is extensive, the enamel is also involved. The enamel becomes hypoplastic, and sometimes its formation is entirely interrupted.

Figure 13 is a part of a central incisor of a normal animal. (Fig. 2.) The enamel was lost in the process of decalcification in preparing the slide. At *A*, the ameloblasts lining the surface of the enamel are visible. The dentin, *D*, is well calcified, and, toward the pulp, there is a thin regular layer of dentinoid (uncalcified dentin).

Figure 14 shows a corresponding area from an incisor of an animal of the same litter that has been kept on rice and calcium for eight weeks. (Fig. 3.) The structure has undergone severe changes. At *E*, the enamel is about normal, but toward the apex, it becomes thinner and finally disappears entirely. The connective tissue of the periodontal membrane is here in direct contact with the surface of the dentin. The dentin itself is poorly calcified, showing a large number of interglobular spaces and a wide layer of dentinoid, and the borderline between pulp and dentin has a wavy irregular course.

In Figure 15, we see a similar area from an incisor of an animal fed on rice and calcium and in addition one drop of viosterol a week. The same rat was shown in Figures 4, 11 and 12 (right). Here, the calcification of the dentin is much better than in Figure 14. There are fewer interglobular spaces; the dentinoid as much narrower, and the border between pulp and dentin is regular. The outline of the enamel appears normal.

In summarizing and comparing the histologic findings in this experiment, we can say that by adding a drop of viosterol each week to an extremely insufficient diet, we were able to improve the condition of the rats. Although the body weight and growth did not change much, the calcification of the bones and especially of the teeth was considerably better.

In addition to the comparison between the different animals, there are interesting histologic details from the individual teeth, with severe disturbances of enamel formation.

Figures 16 and 17 are higher magnifications of Figure 14. They illustrate the way in which changes in the enamel epithelium cause disturbance in the development of the enamel. In Figure 16, the enamel epithelium, *EE*, has become separated from the dentin, and the space between it and the dentin surface is filled with connective tissue. This connective tissue deposited cementum, *C*, on the dentin after the enamel epithelium became separated.

Figure 17 shows another area of hypoplasia of the enamel found on the labial surface of the same incisor. The continuity of the enamel, *EE*, is interrupted by a deep groove that reaches the dentin. The enamel epithelium in this area is proliferated, forming numerous small enamel droplets, *E'*. Clinically, a defect like this appears as a groove or pit in the otherwise smooth enamel surface.

Experiment 2.—This experiment was carried through under the same arrangement as the former, namely, feeding some animals an insufficient diet and others the same diet plus viosterol. McCollum's rickets producing diet 3143 was used. Figure 18 shows the root ends of four

molars of different animals. Above, left, is the root end of a control rat, fed on a normal sufficient diet. (Compare Figure 6, above, left.) Figure 18, above, right, was taken from an animal of the same litter that was kept on McCollum's diet for eleven weeks. In this root, a wide layer of dentinoid can be seen along the walls of the root canal, the last formed part of the apex consisting entirely of uncalcified hard tissue, dentinoid and cementoid. The alveolar bone is surrounded by light seams of osteoid. (Compare with Figure 6, above, right.) Figure 18, below, left, is the root end of an animal fed for the same length of time on McCollum's diet with an additional drop of viosterol a week. The root shows no uncalcified hard substance at the apex. It is similar to that of the control animal except that the layer of dentinoid on the wall of the root canal is slightly wider. (Compare with Figure 6, below, left.)

Figure 18, below, right, shows the root end of an animal kept under the same conditions except for one drop of viosterol a day. The tooth structures as well as the alveolar bone do not show any deviation from the normal.

A question that is very important in connection with these feeding experiments is the occurrence of caries. Experimental caries in rats has been reported on by workers in this field (Bunting, Howe, Grieves). In fact, caries in rat molars resembles histologically the caries found in human molars. In our experiments, caries was quite frequently observed among the animals fed on McCollum's diet 3143. We could find no relation between the occurrence of caries and deficiency in Vitamin D.

Figure 18, above, shows caries in a molar of an animal fed on a rickets producing diet for eleven weeks. Below is a very similar case of caries found in a corresponding molar of a rat that received one drop of viosterol a day in addition to diet 3143. In these cases, we believe that the glutinous consistency of the food was more responsible for the occurrence of caries than the presence or absence of vitamin D. This should by no means be considered a definite conclusion, as statistics taken from a much larger number of rats would be necessary to answer this particular question.

Experiment 3.—In this experiment, all animals were kept on a rickets producing diet for four weeks. Then, one drop of viosterol a day was added. The roentgenograms of the knees of these rats are shown in Figures 7-8.

Figure 20 shows sections through the femurs of some of these rats. Above, left, is shown the knee of a control animal that was kept on a normal sufficient diet. The calcification and the width of the cartilage are normal. The section above, right, was taken from a rat kept on McCollum's diet for five weeks, after which it was killed. One can see the wide zone of cartilage between epiphysis and diaphysis, which also shows up in Figure 7, below, center. Starting with the day when this animal was killed, another rat of the same litter that had been kept under the same dietary conditions received one drop of viosterol a day for three weeks. The roentgenograms of this particular animal are shown in Figure 7, below, right, and Figure 8, above, right, and below, right. Figure 20, below, left, is from an animal that was kept on diet 3143 for eight weeks. Development of a thick layer of cartilage between epiphysis and diaphysis, a thickening of the shaft of the femur toward the end and the presence of enlarged layers of osteoid in the bone char-

acterize the pathologic changes. Figure 20, below, right, shows the femur end of the rat on diet 3143 for five weeks, then given one additional drop of viosterol a day for three weeks. The shape of this femur end is almost like the one of the control animal in Figure 20, above, left. The bone as a whole is frailer. Its calcification is normal. The cartilage is very little enlarged, and its borders are slightly irregular.

The corresponding changes in the incisors of these four animals are shown in Figure 21. Above, left, is the incisor of the control animal with good calcification of the dentin. In the section below, left, which was taken from a rat kept on diet 3143 for five weeks, the dentin is poorly calcified with abundant interglobular spaces and a larger layer of dentinoid. It should be emphasized that there is not such a great difference between the calcification of the dentin of these two rats; whereas, the bone of the femur of the same two animals shows a marked difference. (Fig. 20, above.) Frequently, we observed that rachitic changes in bones and teeth do not necessarily occur to the same extent.

Figure 21, above, right, shows an incisor in which the calcification of the dentin is greatly disturbed. For about two-thirds of its thickness, it is uncalcified, there being only a few globuli of calcification in this area. And, finally, in Figure 21, below, right, is a section from the incisor of a rat that was kept on diet 3143 for eight weeks with one drop of viosterol a day additional for the last three weeks. The calcification of the dentin is about the same as in the control animal.

CONCLUSION

White rats react very readily to variations in the vitamin D content of their food. The absence of this vitamin causes severe rachitic changes in the bones as well as in the teeth, the incisors especially showing very poor calcification of the dentin. In some cases, enamel hypoplasia was produced experimentally. The administration of a vitamin D preparation is able to prevent the occurrence of such changes, or at least to improve conditions considerably by bringing back to normal the structures and the calcification process of the developing teeth.

SUMMARY

1. Experimental avitaminosis in rats can be greatly influenced by the administration of a vitamin D preparation such as viosterol.

2. If rats are fed on a diet insufficient in vitamin D, pathologic disturbances in the calcification of the teeth and bones may be prevented by an addition to the diet of a certain amount of a vitamin D preparation.

3. Rachitic changes that have already occurred may be favorably influenced by such a preparation.

4. The changes that occur in the animal show individual variations as far as skeleton and teeth are concerned. In some rats, the disturbances are more severe in the tooth structures; in others, in the bones.

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DENTIST, PHYSICIAN AND STOMATOLOGIST: WHAT WE WOULD HAVE THEM BE

By CHARLES M. PETERS, M.D., D.D.S., Jersey City, N. J.

A DENTIST, according to Worcester's dictionary, is a tooth surgeon or tooth doctor. Published in 1883, this dictionary, the standard at that time for schools, conveyed to the younger minds the meaning of the word "dentist."

What progress the profession has made since the tooth-doctor age! From a purely mechanical "trade," the steps have been definite and upward. The training in years gone by meant an apprenticeship to a practicing dentist for a period of from one to five years, or attendance at a college of dentistry for two years. Later, this requirement was changed. A man desirous of studying dentistry was required to have a high school education or the equivalent, and then to attend a dental college for three years. In 1917, the requirements were further augmented. Four years of training in a college of dentistry was required. Beginning in 1921, a year's predental education in an approved college, the curriculum dealing with the fine arts and sciences, became necessary for entrance in a recognized dental school. Finally, in 1925, two years of predental work was made necessary before matriculation in a dental institution of higher learning. Some colleges, today, require even more than two years of predental education for entrance.

Simultaneously with the changes in prerequisite dental requirements, the privately owned dental schools were gradually being absorbed into dental departments of leading universities, until today there are few independent dental schools in the United States or Canada.

Medical men have, for the last decade,

been meeting their dental brothers on terms of equality. With the growing recognition of the importance of oral hygiene, oral infection and oral manifestations of systemic disease, the two professions are allied in spreading the gospel of health to the layman. Not only for educational purposes are the two allied "healing sciences" becoming more closely interwoven, but also to facilitate diagnosis and early treatment of pathologic conditions, and in so doing to lengthen the span of life.

To say that the blending of the two professions is complete would be a gross misrepresentation. Some practitioners (both professions being included), for economic reasons, will never condescend to become harmonious. I personally feel that the dentist has not sufficient training in clinical medicine to warrant his being considered proficient in certain specialties, in which stomatology leads.

Stomatology, a neglected phase of medicine, is not within the province of dentistry. As defined in Steadman's Medical Dictionary, this specialty pertains to the treatment of diseases of the mouth and teeth and their relationship in systemic conditions.

The dentist, it is true, knows the various diseases affecting the oral cavity, but his training is limited. The medical man, with his superior knowledge of systemic conditions, his more thorough and wider knowledge of anatomy, pathology and like subjects, is better fitted for the rôle of the stomatologist.

In oral surgery, although this is a dental specialty, the same conditions hold true. With the dentist limited in his field, the superior knowledge of medical subjects tends to proclaim the medically trained oral surgeon more efficient. By this, I do not mean to slur the oral surgeon without the medical degree. Such a point is irrelevant. I am merely advocating the practicability of having a thorough medical training coupled with a dental training, already thorough, to insure the acme of specialization.

This leads to an important object of this paper, the establishing of separate and distinct departments in the general hospital where the specialties of these discussed branches pertaining to medicine and dentistry can be practiced by men who have combined the two professions in their studies. The advantages of this are varied and numerous. Primarily, the patients would be benefited by treatment from men whose knowledge of existing conditions makes them more thorough, and diagnosis would be easily accomplished, assuring, in some cases, a lower fatality rate.

Secondarily, the city, county and state would be saved the expense, in a great number of cases, of having public charges on their hands because of a lack of knowledge demonstrated in incorrect diagnosis and therapy. The establishing of these departments would ensure a more efficient corps of practitioners, saving money and time for the community.

Tertiarily, better training facilities would be offered to the younger element desirous of pursuing these specialties. With a department presided over by efficient masters, it is readily seen that the students' advantages would be manifold. With competent trained men acting as heads of departments, nothing but accurate knowledge, acquired in a correct, concise manner, would be invested in the students. The last advantage of a separate department is most important, for only with men schooled properly, with competent chiefs of staff, can the evolution of these specialties be hoped for.

Various plans have been suggested for the combination of medical and dental

studies: the Owre, or Columbia University, plan (of Dr. Owre, dean of the School of Dental and Oral Surgery); the California plan, proposed in 1925 by Guy S. Milberry, dean of the Dental School of the University of California, and numerous other plans, more or less embodying the ideas above mentioned.

Italy, a few centuries ago, was the world's center of medical training. The Italians are again bidding for that distinction. By royal decree, all dentists must be qualified in medicine and surgery, and every medical graduate must also acquire considerable knowledge of dentistry. At last, the teeth are to be recognized, at least in Italy, as a part of the human organism, as much as the eye or ear, and not as so many stones which Nature threw into the mouth for good measure, and which have no physiologic connection with the other bodily structures.

Other foreign countries, of which Germany is a good example, follow this plan. They have a university graduate dentist, known as *Zahnarzt,* and another type of practitioner corresponding to our own dental mechanics with the one exception that they are permitted to operate in the mouths in all except surgical cases in the treatment of diseases relative to the oral cavity.

In Germany, the attempt to encourage men to become specially trained is brought to the fore by the restriction of the dental mechanic. This plan has its fallacies in that it would tend to create two dental professions. We are not striving for a division in the dental profession, but for its *elevation.* This can be brought about only by a change in the present educational system.

Dentistry should be considered a specialty of medicine and should be studied after the routine medical course. As it has been proved that the two professions are analogous to a great extent, a condensation of the medical course could be arranged by cutting one or more years from the original course of study. Dentistry can then be studied in its entirety as a specialty for a period of two years. This would bring the combined course to five or six years at the most. To insure universal harmony, every recognized university should adopt similar entrance requirements and a similar curriculum.

After the completion of these studies, a full year's, or even two years', internship in a hospital where a special dental department is maintained, under supervision of trained, competent practitioners, should be required of a graduate before he enters on the practice of these specialties.

As it is at present, the dentist, on graduation, steps into the practice of his profession without any clinical experience other than that acquired in his school days. What a gross mistake this is! We all realize that experience comes only through the opportunity of treating diseases *en masse,* by which is meant that clinical knowledge is gained only after the treating of patients suffering from various ailments, at the place these people congregate in a body, the general hospital. Here is presented the chance for the dental intern to become familiar with the various pathologic conditions, more so than in private practice, especially one's practice at the outset of his career, when patients are few and far between. A dental graduate, like a medical graduate, should live in the environment of his profession and apply himself to the studies of his science from the beginning of the day until its end, by actual contact with pathologic conditions at the bedside.

May it be suggested that, coupled with this dental internship, a regular medical

internship be pursued. In order to recognize pathologic conditions that one must handle, and become familiar with through handling; to know the various conditions, and to be able to visualize and make deductions as to the body as a whole, it is thereby recommended that internship should include both medicine and dentistry. The dentist has a theoretical knowledge of disease, but he lacks the initiative which should be forthcoming from the medical profession, and only after this training should a man be looked on as a stomatologist.

The forestated ideas have been proposed with no malice toward the dentist of ten, twenty or thirty years ago (I am a man of twenty-five years' experience in the active practice of medicine and dentistry, specializing in oral surgery and stomatology), but rather with the idea of uplifting the profession as a whole.

The dentist of yore has taken upon himself to remain in the background when he should have forced himself to the fore, not realizing that dentistry was, and is, in reality a specialty of medicine and deserves a place in the medical world alongside the other specialties of that science. The medical man would surely call himself a specialist were he to put four years in the studies of the intestines, the heart or the brain. Why cannot the dentist be recognized as an equal specialist after spending the same length of study on the teeth? Who among the two professions will deny that the oral cavity is an important part of the human body?

Dental and medical men should not be restricted to their own societies and study clubs. A closer mingling of the two professions would benefit them both. A common society, a place where topics pertaining to the sciences, ethics and other phases of both professions can be treated and rendered workable for the advancement of the professions would tend to uplift dentistry, since some dentists of today consider their profession more as a business and resort to various forms of advertising. The higher ethical plane of the medical profession would make these men more desirous of practicing dentistry in the proper manner and spirit. Therefore, such a unity is desired. We of the dental profession have been reluctant in the past, probably because of a lack of knowledge in medical subjects as presented by the dental curriculum of the colleges of days gone by, to attempt to band together. Today, with the training in the medical subjects that the dental colleges require of their students, one need not be reticent, because of a lack of knowledge, about voicing the desirability of a common society.

Let us band together to enact proper legislation, regulate our college systems, educate the laymen and, above all, educate members of the allied professions to the true status of the dentist. As we rely on the older men, as well as the younger, in the profession, let us apply ourselves and work for the dentist of tomorrow!

921 Bergen Avenue.

The Journal of the American Dental Association

212 East Superior St., Chicago, Illinois

C. N. JOHNSON, Editor

Published by the American Dental Association

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Editorials

EDUCATIONAL MESSAGES

At the recent meeting of the American Dental Association held in Memphis, the Board of Trustees approved a plan sponsoring the use of educational messages. This idea was presented to the House of Delegates as a part of the recommendations from the Board of Trustees.

Later, the Committee on Amendments to the Constitution and Administrative By-Laws presented a standing resolution authorizing the Board of Trustees to appoint a committee to have control of educational publicity, this committee to be a part of the Bureau of Public Relations of the American Dental Association.

As soon as these resolutions were passed by the House of Delegates, the Associated Press and other news organizations gave wide publicity to the fact that the American Dental Association was going to use educational messages for the purpose of furthering the interests of oral health and hygiene. As these educational messages

are to be run in newspapers and magazines, the idea was distorted by some of the papers by reference to the movement as advertising.

It is because of these misunderstandings which have arisen through the public press that we believe it necessary to state the matter as clearly and concisely as possible for the benefit of the members of the American Dental Association.

The history of the present movement dates back to the time when a group of dentists in Little Rock, Ark., began using educational messages in the Little Rock papers. This was a new idea and one which attracted much attention, not only in the profession, but also in advertising and public circles. A group of dentists in Little Rock who sponsored these messages believed that such a plan would tend to familiarize the public with the importance of dental care. Owing to the great amount of interest that was created in this campaign, it soon became evident that, for various reasons, educational publicity work was going to be carried on by various groups of dentists in different parts of the country.

At the time of the Memphis meeting, it was authentically proved that more than eighty dental societies, components of the American Dental Association, and one state society had definitely voted to use, or were expecting to use, our educational messages. It was not a question as to whether the Board of Trustees and the Officers of the American Dental Association believed in the use of educational messages through the public press, for that question had already been decided by various societies and the messages were being used.

A careful study of the Little Rock campaign revealed the fact that the idea as a whole was sound, logical and ethical. No real and valid objection could be presented against the plan. The only thing that remained was for the American Dental Association to allow these educational plans to be carried out regardless of whom they were sponsored by, or what type of messages were used, or to provide a plan whereby these educational messages could be controlled by the American Dental Association.

We have already suggested that the present plan consists of a committee, the purpose of which is to pass on all educational mes-

sages that are to be run by local dental societies. This committee has also decided to approve certain educational material that is submitted to them by approved agencies.

It is indeed fortunate that all concerns interested in this campaign have agreed to submit their educational material to the committee for approval.

Up to the present time, the educational committee has approved material which has been supplied by two national agencies. Such educational messages as have been approved by the committee are supplied to the local dental societies for publication in the local newspapers. The dental society pays the newspaper the usual rate for carrying all such messages. The educational messages will be published as being approved by the local dental society which is a component part of the American Dental Association.

In order to make these educational messages more effective, and to give the proper amount of information to those who may become interested, the telephone number and address of the secretary of the local society should be carried in the message. Experience has proved that a great many people make inquiries and ask questions regarding the information contained in the messages. This was demonstrated by the fact that the messages first sponsored by the group of men in Little Rock were signed by the dental educational committee. No address was given. The newspapers received many letters from people asking for further information regarding the educational messages. By tracing these inquiries, it was proved that these messages were being read by people who had previously paid little or no attention to oral hygiene and dental health.

It has been estimated that not more than 40 per cent of the American public pay any attention to oral hygiene. Probably less than 20 per cent visit a dentist regularly. It is believed by many that by the use of educational messages, it will be possible to educate some of the 60 per cent of the people who do not pay any attention to oral hygiene to realize that dental health is very important to general health.

M. D.

THE POSSIBILITIES OF 1932

It is well to check up once in a while and take stock of our professional progress, and the beginning of the year seems a propitious time for this purpose. The past year has brought nothing really revolutionary in dental practice, but in summing up the activities of our state, local and national organizations, we believe that there has been a steady advance and a deeper insight into our various problems.

One thing is still needed and that is a better standardization of some of our technical procedures. We have prided ourselves on the perfection of our technic in the practical branches of our calling, and in certain departments of our work we have really wrought wonders in this regard. Some of the technical achievements in dentistry must command the admiration of the world, and surely science itself has seldom witnessed anything more beautiful. This is particularly true in all restorative work, such as the replacement of lost teeth or portions of teeth; crowns, bridges, inlays and partial and full dentures.

But, without invidious comment, we still contend that there is need for a better standardization in some of our methods, particularly those connected with full denture construction. Although many able minds have devoted their best energies toward a solution of the full denture problem, there is far from an agreement concerning the principles that should govern this work. This is not saying that progress has not been made. It has. Many wonderful achievements have accompanied the struggle along the way toward a truer standardization, but that the ultimate has been reached, no one need claim.

And mayhap there is a reason. Might it not be well for our full denture men to recognize the fact that uniform technical methods will not always bring uniform results? Is it not pretty nearly true that each edentulous case is a law unto itself? This complicates immeasurably the problem of standardization, and

yet we must have standardization as a basis on which to work. But the moment full denture work is carried on in a routine way without recognition of the individual peculiarities of each case, there is certain to result much grief and disappointment. Is it not due to the fact of personal idiosyncrasies that much confusion has resulted in full denture work? The full denture men have not had an easy time of it, and they never will till a complete recognition is had of the variability of their problems as presented in different mouths as they appear one after another. Much headway has been made, but the coming year should see additional light on this subject.

Another thing that 1932 should bring about is a new note in our dental society papers. Too frequently we are treated to the same old rehash of the various subjects in our literature. We cannot, of course, have something new or revolutionary all the while, because new and revolutionary things do not occur every day, but surely the same old stereotyped treatment year after year may be improved on if our essayists and speakers will study their subjects a little more carefully, and prepare their papers sufficiently in advance of the meetings and with more meticulous care. To leave the preparation of a paper till the last minute and then hurriedly throw it together is not to produce the most finished article. There is a real obligation involved in presenting a paper before an audience of one's colleagues, and unless there is something in the paper to improve the mental caliber of the listeners, there is little to be gained by the presentation of the paper.

Time is an important consideration in our modern life, and the wasting of time through the presentation of indifferent material before our societies is a serious matter. The coming year should see an improvement in the quality of our society proceedings, and consequently in our periodical literature. We shall either be better or worse in this regard than we were in the year just past. We shall never be quite the same during another year—it is not in the cards. Whether we shall advance or recede depends wholly on our own efforts—it is up to us.

THE RESPONSE FROM THE CHRISTMAS SEALS

At the time of this writing (December 8), it is quite impossible to estimate accurately the result of the sale of the seals for this year, but from present indications one thing seems evident—that while the prevalent depression may interfere somewhat with the returns from the sale, the effect is not nearly so apparent as had been expected. Not that there is any question about the depression—that is only too evident—but that a new spirit is manifest this year cannot be denied. Never before have we seen such an outpouring of sentiment in favor of the Relief Fund as was apparent immediately following the distribution of the seals. Most of those who felt that they could not respond were good enough to write, expressing their hearty approval of the fund and their regret that they were unable to contribute. And many of them responded even though handicapped by financial stringency and in various other ways.

Some of these members have demonstrated a heroism that is nothing short of the sublime. Here is one man who tells us that he has just lost his right arm, but that he has been practicing writing with his left hand, so that he can sign a check for the Relief Fund. And the check comes in accompanied by his letter written in school-boy penmanship, showing that he has had to learn to write over again. Verily, one-half of the world has no conception of what the other half is up against, and, more significant, what the unfortunate half is trying to do to carry on in the face of every obstacle. The sublimity of this man's attitude and the spirit displayed under such an appalling calamity is enough to sanctify the souls of our entire membership; and when the records of men are placed on the balance sheet of time, this one act will weigh heavily against all of the petty narrowness, and envy, and spite that small minds have displayed since the world began. We trust that this man may never want for any of the material things of life, and we also hope that his example may serve to broaden the minds and expand the sympathies of all of

those who read his story. Surely every seal used on this man's mail must carry with it a special blessing, and if the real facts of his sacrifice could be known and the spirit of his donation be publicly revealed, it would bring from our membership such a response as would warm the hearts of the entire profession. To adequately match this man's magnanimity would soon place the Relief Fund beyond the question of a doubt as to the ability of the Relief Commission to care adequately for all of our needy and worthy members. Think this over.

Another member sends a check for $3.65, the significance of which is obvious, and makes the most appropriate suggestion to the Secretary of the A.D.A. that a proper slogan for the future would be "A penny a day for the Relief Fund." This also is worth thinking over.

One of the most gratifying things connected with the present campaign is the cordial attitude displayed by our members, which, as has been intimated, has heartened everyone connected with the enterprise. Nearly all of those who were unable to contribute wrote that they hoped to be able to do so next year, and one man said that he wanted to double his subscription this year even in the face of financial stringency, for fear that he might have forgotten to do so on some previous occasion, or lest some other member might be unable to contribute this year.

This is the spirit that keeps alive the enthusiasm of the officers, the members of the Relief Committee, the Relief Commission and all of those who have this project most at heart. The amount of time and energy that are expended each year in building this fund can never be realized by the membership generally. If it could, the fund would promptly be raised to a sum that would permanently protect every unfortunate member in our ranks. May this happy consummation some day soon be realized.

THE RECENT DEBACLE

In common with every other class of society, dentists have been somewhat hard hit by the universal economic depression. Our

stacks of cards have been tumbling about our defenseless heads in an appalling and bewildering way, and few of us have escaped a moiety of the financial distress that has swept the nation, and all nations.

But why grouch! There has been some real grief to be sure, and there have also been specific instances of individual disaster, but mostly there has been too much senseless whimpering and too much lamentation for our own good. Must we have a straight run of prosperity through life with never a bump to bring us to our senses? Are we to be immune to the influence of cause and effect? Shall we not expect to reap what we sow?

The whole world had come near to being money mad. Seldom since the days of Sodom and Gomorrah have we seen such inflation, such extravagance. Mortgaging the future was the mirage that misled us, and buying on margin, our great indoor sport. We reached and reached with the fatuous notion that we could never overreach. We forgot the homely proverb that "chickens come home to roost." We lost sight of the fundamentals, but the fundamentals are always there. And then, of course, the crash came, as come it always will under the circumstances.

Is there any consolation? Very much. Difficult as it may be for some of us to realize it, the past year has provided us with the most beneficial experience that we have ever had. We have been forced to face facts, and that is always salutary. Gradually, we are acquiring a wholesome estimate of the values of life; the real values, represented not so much by the material things of our existence as by the more subtle and surer entities of moral responsibility and integrity. This is what we most need.

To acknowledge a moral obligation is better than to reap a great financial reward; to be honor bright is better than to be ever so bright without honor. We have been skating so long on the thin ice of speculation that the wonder is that we did not fall in before. We have failed to keep our feet on the solid ground of conservatism and sanity, and now perforce we are gradually turning from the irresponsible and the frivolous to the sober and serious issues of our lives. After this severe lesson, we shall all be

better. We shall gain a clearer vision of the real issues of life, and profit by the stresses that we have had. We shall be surer of the significance of our tendencies, and more certain of the clarity of our aims. We shall eliminate much of the ulterior and the superfluous, and get down to the basic realities of our existence. We shall respect our obligations more than we have ever done, and we shall have a greater care about making promises without due regard as to how readily or surely they may be fulfilled. We shall not plunge headlong into enterprises without due deliberation as to the possible consequences. We shall be surer of our ground in every aspect of our economic and professional lives, and altogether we shall benefit by the reverses that we have had, distressing and bitter though some of them may have been.

We need these lessons, as a stimulating astringent to our energies. We shall emerge purified by the fire, and sanctified by the sacrifices we have made; we shall be closer knit in our convictions, and clearer in our mental vision. Mayhap in the fruitful days to come, we shall look on our recent experience as one of the most fortunate of our lives, for out of the tribulation comes the deliverance.

THE WORK THAT YOU DO TODAY

The work that you do today should be a bit better than the work you did yesterday. Unless this is true, there is evidence that you are not profiting by experience, and experience is your best teacher. Somewhere yesterday you failed to do your best, somewhere you slipped back a trifle and fell short of a one hundred per cent performance. If you get in the habit of slipping in this way, your whole moral, mental and physical fabric will soon begin to show evidence of demoralization.

Conversely, if the work done today is a little better than that previously performed, and if you aim to keep that up day by day, you are on the sure road to the fullest fruition of which man is capable. The work that you do today is what really counts. The work that you intend to do tomorrow may not materialize.

EDWARD J. HOWARD, D.D.S.

(1880-1931)

Edward Joseph Howard was born in Vallejo, California, May 1, 1880, and received his early education there.

Sept. 3, 1901, he entered the College of Dentistry, University of California, where he completed the degree requirements, May 18, 1904, receiving his degree in Berkeley as one of forty-five graduates in dentistry. After graduation, he located in San Francisco, where he practiced until 1906. In April of that year he went to Launceton, Tasmania, where he was associated with Ray McClinton in practice until 1912, when he returned to California.

Again establishing an office in San Francisco, he began practice, continuing there until his death, Nov. 16, 1931.

Energetic throughout his whole life, deeply interested in the affairs of his profession, he sought the opportunity to serve and was honored in many capacities. His first contact was with the alumni association of his own school, which he served as secretary in 1912-1913, vice president, 1913-1914, and president, 1914-1919, with success. When he relinquished the helm of this organization, he did not lose interest in it, for his counsel and advice were sought at all times in matters pertaining to university welfare. In such esteem was he held that he was again called to the presidency of his alumni body in 1927, serving until 1931. No other alumnus has been so honored.

His activities were not confined to a single organization, for he became equally interested in the welfare of the county and state dental organizations.

Proving his worth as a member of various committees and showing good executive ability, he was made chairman of the program committee of the convention of the California State Dental Association, held in June, 1923, and, because of his success, he was made president-elect in 1923-1924, succeeding to the presidency in 1924-1925. In this capacity he again earned high commendation for his splendid service.

Possessed of a fine, companionable nature, he found an outlet for his social tendencies through the activities of the Elks Club, of which he was a member, and through contact with a host of friends. Jovial in disposition, charitable in heart, considerate of those whom he served, loyal to his friends and his profession, sincere in his faith, his life was well lived. None more than he held the esteem of his colleagues in California.

GUY S. MILLBERRY.

COUNCIL ON DENTAL THERAPEUTICS

ACCEPTED DENTAL REMEDIES

The following articles have been accepted as conforming to the rules of the Council on Dental Therapeutics of the American Dental Association for inclusion in the list of Accepted Dental Remedies. The Council desires dentists to understand that the admission of an article does not imply a recommendation. A copy of the rules which govern the Council in the consideration of articles will be sent on request. SAMUEL M. GORDON, *Secretary*

ALPHANAPHTHOL.—Alphanaphthol.—1-hydroxy-naphthalene, $C_{10}H_7OH$.

Actions and Uses: The actions of alphanaphthol resemble those of betanaphthol. It is antiseptic and germicidal, being several times more actively antiseptic than phenol. When applied to the skin or mucous membrane, it is irritating, and absorption of considerable amounts may cause nephritis. The literature on its toxicity as compared to that of betanaphthol is rather contradictory but it is probably of a similar order. Alphanaphthol is generally not used internally.

Dosage: Externally, solutions containing from 0.1 to 1 per cent of alphanaphthol may be used. As a gargle, mouth wash, etc., solutions containing 0.05 to 0.5 per cent may be used.

Properties: Alphanaphthol occurs as colorless or faint gray glistening crystals, or a white crystalline powder, possessing a faint phenolic odor and a pungent taste; readily soluble in alcohol, ether, chloroform and benzene; very slightly soluble in hot water and practically insoluble in cold water, and readily soluble in aqueous solutions of alkali hydroxids. A saturated aqueous solution is neutral to litmus. Alphanaphthol melts at between 93 and 95 C.

Compound Solution of Alphanaphthol: Alpha-Naph-Co contains alphanaphthol, 10 gm., glycerin, 32 gm., soft soap (prepared from cottonseed oil and potassium hydroxid), 23.8 gm., water to make 100 gm., glusid and essential oils to flavor.

Actions and Uses: See preceding article under Alphanaphthol. When tested against *B. typhosus* by the U. S. Hygienic Laboratory method, Alpha-Naph-Co has a phenol coefficient of 1.46.

Dosage: See preceding article under Alphanaphthol.

Manufactured by the Carel Laboratories, Redondo, Calif. No U. S. patent or trademark.

Alpha-Naph-Co Dental Cream: Composition: Each 100 gm. contains Alpha-Naph-Co compound, 2 gm.; magnesium carbonate, 8 gm.; calcium carbonate, 46 gm.; sapo pulvis, 6 gm.; amylum, 1.5 gm.; gelatin, 0.5 gm.; glycerin, 15 gm.; water, 20 gm.; saccharin and volatile oils to flavor.

Claims: The manufacturer has agreed to make no claims of a chemical, therapeutic or bacteriologic nature in the sale of this tooth paste.

Manufactured by the Carel Laboratories, Redondo, Calif. No U. S. patent or trademark.

CALGLUCON EFFERVESCENT TABLETS: Calglucon 4 gm. (60 grains) in an effervescent base composed of sodium bicarbonate and tartaric acid. [See J.A.D.A., 18:2010 (Oct.) 1931.]

Manufactured by the Sandoz Chemical Works, Basle, Switzerland. (Sandoz Chemical Works, Inc., New York, distributor.)

BUREAU OF CHEMISTRY

DR. BELL'S GUARANTEED PYORRHEA REMEDY: ANOTHER PYORRHEA NOSTRUM

The following is a report of the A. D. A. Bureau of Chemistry.

SAMUEL M. GORDON, *Chief.*

In the early part of September, 1931, letters sent to dentists by the Rankin-Bell Laboratories, 690 Market Street, San Francisco, Calif., were received at the A. D. A. Bureau of Chemistry. The Rankin-Bell Laboratories are the sole owners and distributors to the dental profession of R-B "Kleen Dent," for cleaning teeth, "Py-Or-Ex" Tooth Powder, and Rankin's "Miracle" Denture Powder, in addition to Dr. Bell's Guaranteed Pyorrhea Remedy, which is the subject of this report. A Dr. E. Francis Bell (D.D.S.) appears to be the guiding genius of the company.

The letter is interesting as an example of the methods used to get dentists to try out a product. The letter, which is accompanied by other advertising, urges the recipients "to read the enclosed folder carefully, thoughtfully and with an 'open mind,'" for, the story goes, it contains "some remarkable statements—statements that may be at variance with your teaching and experience." The Rankin-Bell Laboratories, in their letter, answer questions which have "popped up" (sic) from time to time in their work with dentists; namely, "'How about these 30,000 treatments without a single penny of refund requested?'" and "'What neutralizing and restorative agents are used in your pyorrhea remedy?'" Because the Rankin-Bell Laboratories naively assume that they have answered the second question on another piece of advertising, it is reproduced in full in order that readers may read the "remarkable statements" it contains. The statements are remarkable not for what they tell, but rather for what they do not tell. According to this advertising, "Dr. Bell's Pyorrhea Remedy Contains:

A remarkable "Cleaner and Polisher" that will not scratch or abrade the enamel, cementum, gold work or fillings.

An "Absorbing Agent" that will absorb the pus and the germs that create it, and entirely eradicate them from the system.

A "Chemical" that, when moistened, releases Oxygen gas that carries with it the "Absorbing Agent" and penetrates anywhere the Pyorrhea germs can penetrate.

A "Cleansing Agent" that cleans the pus pockets *chemically* clean after a few applications.

An "Astringent" that tightens the gums and holds them tight until the "Healing Agent" it contains firms the gums and heals them and also eradicates ALL free matter from the pus pockets.

A "Mild Laxative" to neutralize the astringent effect when swallowed.

A "Germicide," that is a "Tonic" that tends to create circulation of blood in the gums.

An "Antiseptic," the action of which is indicated by the term.

These Agents in combination, and when prepared according to our own Process, NEVER FAIL when the Remedy is used as directed. Destroy and Eradicate the germs, the pus, the disease, the congestion and inflammation—start a new circulation in the

parts—and Nature heals the old wounds thru the Regenerative Processes familiar thruout life. Result—PYORRHEA GONE NEVER TO RETURN—unless there is an absolutely new infection.

What the "chemical," "astringent," "mild laxative," "germicide" and "antiseptic" or their combination in Dr. Bell's Pyorrhea Remedy are is skillfully avoided.

The answer to question 1 is still more devious. The recipients of the letter are informed "Our Research and Experimental Department *SOLD* 30,000 packages of this Pyorrhea Remedy to the *LAITY* covering more than 10,000 cases of Pyorrhea in all stages of advancement . . ." with an absolute guarantee of money refunded if results were not absolutely all that were expected, but in four years, no refund was asked. This apparently was the scientific justification that urged the Rankin-Bell Laboratories to give the dental profession the benefit of their discovery, for the story goes: "If 10,000 Pyorrhea sufferers can *CURE THEMSELVES,* what can't the Dental Profession do with this Remedy with their Expert Training—their Expert Technique—their Intelligent Supervision and Application?" Apparently, this point does not enter the promoters' minds: If the laity can cure themselves, why introduce the remedy to the dental profession?

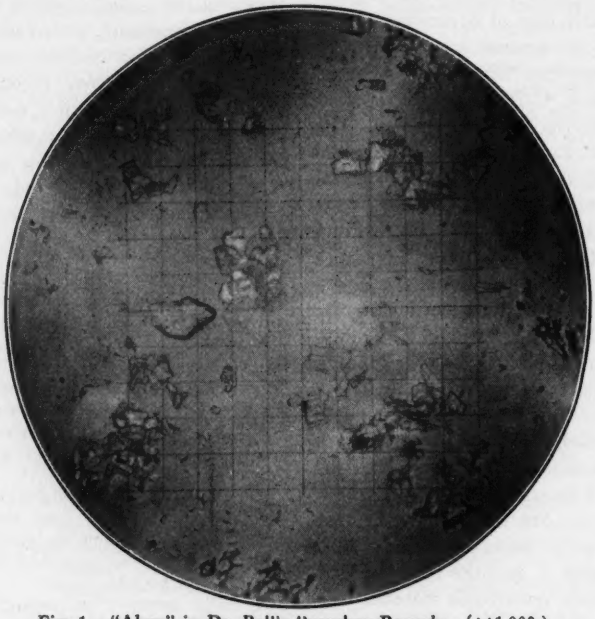

Fig. 1.—"Alum" in Dr. Bell's Pyorrhea Remedy. (×1,000.)

"Pyorrhea Conquered at Last!" is the caption of another piece of advertising. This advertising tells dentists how they may permanently cure pyorrhea, and points out their shame that they have not been able to cure it in the past.

Apparently, all one has to do to cure pyorrhea, regardless of the etiology, is to use Dr. Bell's Guaranteed Pyorrhea Remedy. The story is interesting from another angle, for, by indulgence in a little mathematics, the Rankin-Bell Laboratories compute how the dentist may earn $380 added income a month on an investment of $20. One wonders if the author of the pamphlet is so naïve as to believe that organized dentistry in this country could close its eyes to a scheme which placed profits above the welfare of its patients. Furthermore, one is told that 30,000 cans were sold in the last four years at $10 a can, an outlay of $300,000 on the part of the purchasers; yet Dr. Bell has not produced in writing the clinical evidence so that it may be evaluated by dentists. The outlay in money is important, but it of course fades to insignificance when compared with the possible danger to those who suspect "pyorrhea" in delaying to seek competent professional aid. It need hardly be mentioned that the advertising for this guaranteed pyorrhea remedy is sent through the mails without the case reports on the 10,000 sufferers from pyorrhea who were cured of this dread disease.

The advertising mentioned above is stated to be written for the Laboratories by Dr. E. F. Bell (D.D.S.).

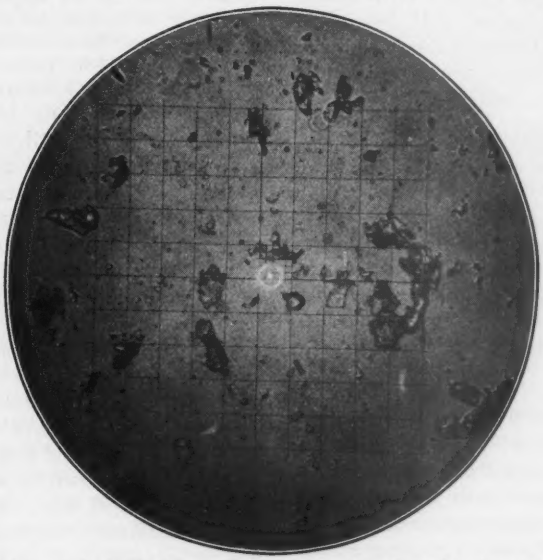

Fig. 2.—Acid insoluble in Dr. Bell's Pyorrhea Remedy. (×1,000.)

WHO IS DR. BELL?

Subsequent correspondence with the Rankin-Bell Laboratories was signed by "E. Francis Bell, D.D.S."

No record of E. Francis Bell appears in Polk's Dental Register for 1925, or in the 1928 edition. He is not a member of the American Dental Association.

Our records show that a Dr. Emil Francis Bell received a degree in dentistry in 1904, and practiced for a num-

ber of years in Erie, Pa. Although his address is given as San Francisco, Calif., he is not licensed to practice dentistry in that state.

Dentists in San Francisco who were consulted, informed the Bureau that signs at 690 Market Street, the address of the Rankin-Bell Laboratories, carry the title "D.C."; that is, doctor of chiropractic, after the name E. Francis Bell. The Bureau is also informed that Dr. E. Francis Bell was secretary of the local chiropractor's society for a number of years. The August, 1931, issue of the San Francisco telephone directory carries the following boxed announcement under "Chiropractors, Anatomical":

> Bell, E. Francis. Specializing in Gland Therapy. A complete health service without drugs, medicines (sic) serums or surgery . . . Gland Booklet "T" on Request . . .

Dr. Bell's telephone number is the same one as that of the Rankin-Bell Laboratories. One cannot but wonder why Dr. Bell would sell a "pyorrhea cure" at $10 a can, when he advertises a complete health service without drugs or medicines.

CORRESPONDENCE WITH THE RANKIN-BELL LABORATORIES

In order to give the Rankin-Bell Laboratories an opportunity to make a frank statement of the composition of the product they were promoting, a communication was sent to them, Sept. 29, 1931. On the following day, there was received in the Bureau of Chemistry a lengthy letter, dated Sept. 28, 1931, signed by Dr. E. Francis Bell, repeating, in the main, the statements in the advertising already mentioned. This letter was apparently prompted by an investigation made for the Bureau by some of its correspondents in San Francisco. In addition to putting the advertising statements in other words, there was a lengthy peroration on "Scientific Experts" and "Clinical Evidence," repetition of which might be of interest in this connection:

> Of course we know Scientific Experts and Research Men do not accept "Clinical Evidence" as a criterion of a "Cure" or "Permanent Relief." We know they "Approve" or "Disapprove" any preparation or medication by the negative attitude of saying "That it has never been done before by any of the constituents of the Remedy, therefore it would be *impossible* for it to be done now." "Clinical Evidence," however, to our mind is the most conclusive evidence there is, and we sincerely trust that the various Professions, at no great distant time, will be broad enough to accept the "Clinical Evidence" that is eminently satisfactory to the Patients.

The protest is of interest because in the lengthy advertising for Dr. Bell's Guaranteed Pyorrhea Remedy no clinical evidence beyond the bald statement of 10,000 permanent cures was made available in the advertising sent to dentists. On the other hand, it may be stated that scientific men are not skeptical of clinical evidence properly obtained; they regard it as a valuable means of ascertaining the usefulness of a drug or drug preparation. But clinical evidence means more than the bald statements of someone interested in the sale of a preparation. It is only fair to state that in the same letter, Dr. Bell stated his willingness to send an additional supply of the Remedy for an examination which he understood was to be undertaken, and send to the Bureau of Chemistry, "personally and confidentially" a list of the ingredients of the Remedy. Oct. 2, 1931, the Rankin-Bell Laboratories were advised that the Bureau of Chemistry and the Council on Dental Therapeutics do not accept information in confidence, and that the further course of this Bureau would be guided by their reply to our letter in which a statement of the composition was requested. In passing, it may be repeated that the Bureau of

Chemistry is not interested in the information for itself, but is interested in having information available for the use of the dental profession and the public.

Despite the stated willingness of the Rankin-Bell Laboratories to send the composition "personally and confidentially," they did not seize the opportunity; for the Bureau was subsequently informed that the Rankin-Bell Laboratories had the matter of composition up with the " sole Owner and Inventor of the Formula" who, so the letter goes, advised Dr. Bell as follows:

As to divulging our secret Formula to anyone, we object most strenuously. That information was given to you in strict confidence to help you and it was agreed that you would treat it confidentially. To give it to the learned Doctor for publication could serve no good purpose. If the Dental Profession do not know what WILL cure Pyorrhea, how, then, can they say what will not?

In fairness again to Dr. Bell, it might be stated that he wrote that in view of the various things that have occurred in relation to the pyorrhea remedy, and his effort to be of service to humanity, through the dental profession, which evidently is not appreciated by said profession, the writer had decided to "withdraw entirely from Rankin-Bell Laboratories and also, for the time being, at least, from any effort to supply the Dental Profession with a Remedy for Pyorrhea." It is assumed that Dr. Bell has in mind the investigation initiated by the Bureau and its San Francisco correspondents.

Despite Dr. Bell's statement of service to humanity, and the secrecy regarding the formula of the product for which he asked the public to pay $10 a can, it would only seem fair that they know the composition of what they are asked to pour into their mouths for self-treatment of pyorrhea. If this be denied to the public, there can be no argument whatever that it is not only the right but also the duty of the dentist to know what he is asked to prescribe or recommend. In view of the failure of the Rankin-Bell Laboratories to take advantage of the opportunity to give the composition to the dental profession, an examination was undertaken in the A. D. A. Bureau of Chemistry:

DR. BELL'S GUARANTEED PYORRHEA REMEDY

One (1) original package of Dr. Bell's Guaranteed Pyorrhea Remedy (Rankin-Bell Laboratories, San Francisco, Calif.), price, $10, was received for examination.

The following appeared on the label:

Dr. Bell's Guaranteed Pyorrhea Remedy. For treating successfully—Pyorrhea, Sore and Bleeding Gums, Gingivitis, Trench Mouth and all infections of the oral cavity.—Contains no pumice, grit, acid or anything harmful to the teeth, cementum or the human system.

The package contained approximately 297 gm. (9½ ounces) of a fine gray powder, possessing a slight wintergreen odor, and a saline, astringent and gritty taste. It was only slightly dissolved by water, the aqueous solution of the dissolved portion reacting markedly acid to litmus.

Qualitative tests indicated the presence of an acid insoluble silicious mineral, potassium, aluminum, sulphate and sugar (sucrose). Magnesium, calcium, iron and chlorid were indicated in small amounts. Heavy metals (other than aluminum and iron), iodin liberating compounds, phenols, phenolphthalein and emodin-bearing drugs, borates, phosphates and starch were not found.

Quantitative examination yielded the following:

Loss in weight 100 C.,	3.8 %
Ash 600 C.,	90.1 %
"Hot water soluble,"	8.7 %

"Diluted hydrochloric acid insoluble,"	86.6 %
Potassium (K^+),	0.72%
Aluminum (Al^{+++}),	0.49%
Sulphate ($SO_4^=$),	3.86%
Sugar (sucrose),	1.02%

Microscopic examination indicated the presence of "alum" and pumicite.

Based on the foregoing, the following essential composition may be calculated for Dr. Bell's Guaranteed Pyorrhea Remedy:

Pumicite,	87.0%
Alum (potash alum),	8.7%
Sugar (sucrose),	1.0%
Moisture, flavoring and undetermined,	2.3%

From the foregoing, it may be concluded that a mixture having the essential properties of Dr. Bell's Guaranteed Pyorrhea Remedy may be prepared by mixing together 90 parts of finely ground pumicite, 9 parts of alum, and 1 part of sugar, and adding a dash of oil of wintergreen to suit the taste.

The investigation of the chemist showed that Dr. Bell's Guaranteed Pyorrhea Remedy, sold for $10 a can, for the benefit of humanity, contains nothing more imposing than approximately 90 parts of pumicite, 9 parts of alum and 1 part of sugar, to which a dash of flavoring has been added. Contrary to the statement on the package that it contains no "pumice, grit," the examination disclosed that the product was composed largely of a form of pumice. Is it any wonder that the Rankin-Bell Laboratories would not disclose the formula?

One fails to see how humanity would be benefited by paying $10 for approximately one-half pound of pumicite, modified by the addition of the other ingredients. The statement can bear repetition that the cost is entirely unimportant, even though possibly the public may have parted with $300,000, as compared to the results involved by delaying the proper individual treatment for pyorrhea, a condition which only a competent dentist can diagnose and which should be treated on an individual basis.

In view of the chemist's report, one cannot consider seriously the extreme claims put out by the Rankin-Bell Laboratories. When Dr. Bell submits the evidence that a mixture of pumicite and alum will cure pyorrhea, his claims will be more seriously regarded.

BUREAU OF PUBLIC RELATIONS

NEBRASKA STATE FAIR HEALTH PROGRAM

By E. R. HAYS*, M.D., Falls City, Nebraska

FROM a beginning in 1927 with a 25-foot booth, a few pathologic specimens, some health charts and grotesque photographs of deformed and diseased persons, and a personnel of two physicians, one intern and a window decorator, the health program at the Nebraska State Fair during the past five years has grown into an activity which requires the services of eighty-eight physicians, fifteen dentists, thirty-five nurses and seventeen lay helpers. From the original space of 200 square feet the demonstration now occupies a group of four buildings with 6,500 square feet of floor space.

During the first two years, the program was financed entirely by the Nebraska State Medical Association. Since then, the Nebraska State Board of Agriculture has paid all expenses of construction, which includes the remodeling of an exhibition hall, converting one building into an emergency hospital, remodeling a room into a motion picture theater, constructing eighteen examining rooms, a laboratory and an x-ray room, together with adequate plumbing, wiring and lighting.

Besides this expense of construction, the state board of agriculture has each year since 1929 paid the actual cost of the program. The lay helpers and supervising nurses are paid wages, while physicians, dentists and assistant nurses donate their time.

The state fair was selected as a medium for dispensing health information for the reason that, with its multitudinous and varied exhibits, it is primarily an educational institution. The products of our farms, schools, industries, trades and businesses are exhibited there each year. Representatives from all walks of life seek information on various subjects and knowledge of advancements in all lines of endeavor. Those in attendance are a cross-section of the inhabitants of Nebraska, and this is the largest annual gathering within the state. One-third of our million and a half people attend each year.

Prior to 1927, health education in Nebraska was in the hands of lay groups, the medical and dental professions being called into programs only when it was necessary to make technical examinations. Under that system, the organized medical and dental professions were taking a subordinate place as health teachers. From a survey, we learned that the public preferred to receive information on how to prevent sickness and maintain health from the authoritative source of organized medicine and dentistry, rather than from any other. Yet we were told

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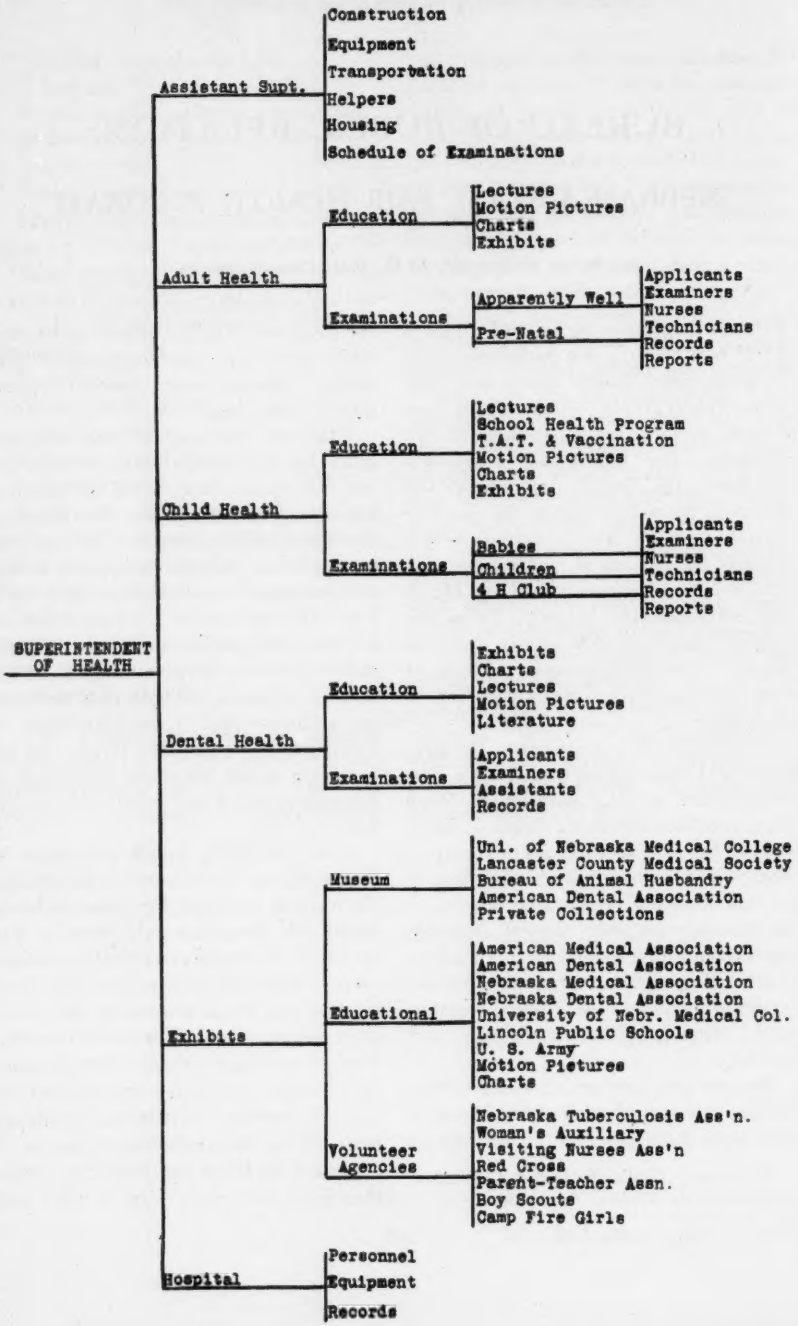
NEBRASKA MEDICAL ASSOCIATION STATE FAIR ORGANIZATION



that if we failed to gratify the public demands for greater knowledge, it would accept the teaching of other organizations and we would be permanently shaken from a position of leadership.

We were convinced that the medical and dental professions could not stand still and allow lay groups and cult organizations to pass them by in this health education work and still hope to retain a respected position in the minds of the public. We must either go forward or

DEFECTS OR ORGANS FOUND TO BE DEFECTIVE IN PATIENTS EXAMINED

Adults: Number Examined, 172

Teeth	79	Visceral ptosis	18	Hay-fever	7
Tonsils	78	Hemorrhoids	16	Male genitalia	7
Nutritional defects	44	Female breast	16	Arthritis	5
Nose	40	Legs	15	Hernia	4
Abdomen	40	Constipation	13	Hyperacidity	4
Gums	36	Skin	13	Anemia	3
Female genitalia	35	Lungs	15	High fever	3
Ears	32	Galibaldder	13	Superficial gland	2
Heart	31	Eyes	12	Diabetes	1
Thyroid	23	Liver	12	Tumor on hand	1
Posture	21	Kidneys	8	Rectal fistula	1
Orthopedic defects	23	Blood (pressure)	10		
Pharynx	16	Sinus	7	Total	715

Children: Number Examined, 101

Teeth	49	Flat feet	9	Sinus	3
Tonsils	48	Chest	8	Knock-knees	3
Nutritional defects	44	Heart	7	Bow-legs	3
Posture	29	Lungs	7	Liver	2
Superficial glands	25	Pharynx	7	Rapid pulse	2
Adenoids	16	Abdomen	6	Knee reflexes	2
Flabby muscles	15	Kidney	6	Hair	1
Skin	14	Orthopedic defects	5	Speech defect	1
Nose	14	Coated tongue	4	Birth injury	1
Male genitalia	12	High fever	4		
Ears	11	Thyroid	4	Total	376
Eyes	11	Winged scapulae	3		

Babies: Number Examined, 193

Teeth	85	Hernia	13	Rickets	4
Tonsils	72	Hair	11	Heart	4
Adenoids	56	Abnormal head shape	10	Fontanel	2
Flat feet	52	Spine	9	Liver	2
Nutritional defects	46	Enlarged epiphysis	9	Ears	2
Knock-knees	37	Bow-legs	9	Curved thigh bone	2
Neck glands	35	Posture	9	Asymmetrical legs and feet	2
Skin eruption	35	Mouth	8	Enlarged thymus	1
Male genitalia	31	Moles	7	Paralysis	1
Chest defects	27	Nose	6	Mental defect	1
Beaded ribs	22	Eyes	6	Tumor	1
Winged scapulae	20	Lungs	6		
Abdomen	21	Female genitalia	6	Total	712
Flabby muscles	17	Scalp	5		
Pale skin	16	Nails	4		

drop far behind. The battle could not be won on the line of defense and we must either supply the extra demand by extra effort or lose to those who would. In other words, we were dictated to by lay committees and lay governing boards, not because they so much wished to direct our affairs, as because we failed to take our place and assume the responsibilities that were rightfully ours.

The great task lay not in urging the public to accept our teachings but in organizing our unorganized groups into teaching units. Preventive medicine and dentistry is truly a problem of education, a problem of educating the medical and dental professions as to how to teach it. It has been my opinion for some time that the reason philanthropists do not contribute their millions to organized medical and dental societies for health education and disease prevention work is that we have not shown that we are capable of organizing and carrying on a comprehensive effective health program. As health workers, we are usually in and outers, seldom having a definite plan or making a concerted sustained effort.

To lead this health education movement is our desire and our prerogative, yet we cannot hope to remain in the vanguard by attacking the cults and charlatans through press or by voice. To paraphrase a famous gridiron expression, "The best defense is a strong offense." By positive constructive action, we must demonstrate what we have in our catalog, and launch, lead and direct complete health programs.

The Nebraska State Fair health program is considered by the Nebraska State Board of Agriculture as one of the most valuable educational features of the Fair. It is directed and operated by the medical and dental professions of the state, under a superintendent of health who is appointed by the state fair board from the ranks of the profession.

The organization, under the superintendent, is divided into six main divisions as shown in the accompanying outline:

1. An assistant superintendent has charge of construction, equipment, transportation, helpers, housing and schedule of examinations.

2. The adult health division is under the head of a director who suggests lecturers, motion picture films, charts and exhibits for the educational exhibit. He also appoints examiners, nurses and technicians for the periodic health examinations and the prenatal examinations. He checks examination records and summarizes reports to be sent to the family physician.

3. The child health division is under a director who likewise suggests educational material and appoints examiners, nurses and technicians for the baby, children and 4-H club departments.

4. The dental health division is directed by the secretary of the Nebraska State Dental Association. He provides charts, exhibits, lecturers, motion picture films and literature for the educational exhibit, and also appoints examiners and assistants to make oral and dental examinations of all applicants in the adult and child health divisions.

5. The exhibits are housed in a separate buliding. A director of exhibits collects, sets up and displays all exhibits. Each exhibit has an attendant in charge who explains the significance of his display and its relation to health.

6. The emergency hospital is equipped, manned and operated by the Lancaster County Medical Society.

The Nebraska State Fair always begins the Friday preceding Labor Day and continues through the following Friday. The health exhibits and moving pic-

tures are shown from 9 a.m. until 6 p.m. on each of the eight days. Two lectures are given every morning and afternoon in the exhibition hall, and a health playlet, given mornings and afternoons by school children, breaks the continuous run of health films.

Beginning on Labor Day and continuing through four days, health examinations are given to babies, children and adults. It is our opinion that in any health program, if examinations are given, it is much better to have them deal with general health examinations than to hold tuberculosis, nutrition, cancer and dental clinics, or any other type with the preconceived idea of what may be found. Such clinics limit the applicants to those suspecting a particular malady and have a tendency to influence the examiner to narrow his scrutiny to limited fields, and thereby neglect to consider the patient as a whole.

The babies are not judged competitively, but, like the children and the adults, are given a thorough examination. It has been our observation that the practice of "scoring" discourages many parents in the idea of having their babies examined. We want parents to feel that their children should receive examinations not for competitive reasons but in order that disease tendencies may be revealed. Applications for examination are received a month prior to the time the fair is in progress, and each applicant is given an appointment. The vacancies are filled from those who apply on the fairground. In the adult division, on account of the influence of the mother in the home, preference is given women applicants. Furthermore, we attempt to choose applicants from all parts of the state rather than to place them in the order in which their applications are received. By so doing, we are carrying this educational endeavor into all sections of the state.

In the morning of each of the four examining days, babies and children up to 5 years of age are examined. In the afternoon, examinations are given children from 5 to 15 years of age, and all adults. All histories are taken by the examining physician, for we believe that too often histories are not read when taken by another, and the important information which histories reveal might not be discovered by examination. The names and addresses of the applicant's family physician and family dentist are first recorded, and he is then asked whether he is ill or under the care of a physician. Should he be sick and know it, or be under the care of a physician, he is refused examination. In other words, we aim only to examine persons who are of the impression that they are well.

The group plan of examining is purposely avoided. The practice of passing the patient from one physician to another for special examinations and then having the correlation made by another creates the impression with the patient that in order to have a health examination, one must consult a group of doctors. The average man concludes that such a procedure is expensive, something he is unable to afford, and rather than have an examination, he waits until he is ailing before he consults his physician or dentist. Our desire at the state fair is to popularize health and to create the impression that the periodic health examination can and should be made by the family doctor and dentist and that a yearly checkup is good business.

Mothers accompany their babies and their other children, and health information is given them as the examination progresses. Adults are stripped to the

waist. A nurse is present at the examination of all female patients. Routine blood counts and urinalyses are made on every patient, blood pressures taken and all chests examined by the fluoroscope. Vaginal examinations are given all female patients.

An eye, ear, nose and throat specialist in charge of one room is consulted when conditions warrant special examination. We are equipped to furnish all the conveniences and safeguards of a modern office. Clean sheets and shoulder capes are furnished all patients and sterile gloves are used for vaginal and rectal examinations. All patients pass through the hands of one of several dentists, who are situated in rooms equipped and furnished as modern dental offices.

Each examiner is required to record the results of his findings and sign his name to the examination blank. He is told that the records will be sent to the patient's family physician and dentist, and with this information, it is certain that he will be most careful with his examination and opinion.

At 5 o'clock each afternoon, a clinic is held covering all the interesting cases discovered throughout the day. The examiner finding the unusual condition is required to present the case to the staff and lead the discussion. This feature of the program holds the interest of the examiners in their work, and much valuable information is gained from the presentation of the cases and the discussions that follow. It can be seen that the physicians and dentists conducting these health examinations are obtaining valuable experience and knowledge. This is in line with our desire to educate the professions. In order that this education may be carried to all corners of the state, the medical and dental examiners are selected from the rank and file of ethical practitioners located in the different sections of the state. To further increase the professional contact, a complete new group of examiners are selected each year. This group is divided into smaller groups, a new unit of medical and dental examiners being available for each half day.

At the 1931 state fair, there were examined 193 babies, 101 children, 172 adults, seventeen expectant mothers, and fifty-six 4-H club boys and girls, a grand total of 539 examinations. Ninety-one per cent of the adults, 86 per cent of the children and 80 per cent of the babies were found to have defects. Only thirty-eight of the babies had been vaccinated and fifty had received toxin-antitoxin. Of the other children, forty-nine had been vaccinated and thirty-three had received toxin-antitoxin.

In listing defects, we had to bear in mind that a periodic health examination does not necessarily mean a diagnosis. The purpose, as I understand it, is to differentiate the abnormal from the normal, and when an abnormal condition is found, to advise further examination. For instance, a defect of vision may be discovered in a health examination, but it would require special examination to determine the etiology, degree and type of defect. Under heart, we have listed many defects. These may mean that an arhythmia or a murmur exists. It is sufficient in a health examination to record a defective heart, the patient being referred to the family physician for further examination, diagnosis and treatment.

The defects, or organs found to be defective, are listed in the accompanying table.

It is worthy of emphasis that 86 per cent of this unselected group ("mine run," as it were) possessed physical de-

fects which, in a great many cases, were leading to serious physical breakdown. These conditions were found in people who were apparently well, and 82 per cent of the defects found could be removed or improved by proper attention.

The records of all examinations are sent to the family physician and dentist designated by those examined, and, in the case of babies and children, to the physician designated by the parents. All patients and parents are notified of this fact and requested to call at their physician's office for an interpretation of the records and advice relative to the correction of defects.

The Public Activities Committee of the Nebraska State Medical Association has had full charge of these health programs in the past. A joint committee composed of members of both the state medical association and the state dental association has now been formed. This coalition undoubtedly will strengthen both societies, increasing our ability to carry health measures to the people and to mold public opinion more effectually.

THE DENTAL PRACTITIONER AND PUBLIC HEALTH EDUCATION*

By RICHARD C. LEONARD†, D.D.S., Baltimore, Md.

THE subject for this paper, "The Dental Practitioner and Public Health Education," has been selected for two reasons: First, because I have, for the past five years, been engaged exclusively in school clinic and public health work. I have, of course, tried to keep up with generalized dentistry through the journals, society meetings and contact with dental schools. But hecolite was just coming into prominence when I was making dentures. "Slice preparation for inlays" is scarcely more than a phrase to me. So it would indeed be offering myself up for sacrifice were I to try to talk to practicing dentists of any operative or technical phases of dentistry.

Secondly, I selected this subject because my five years' experience in field work convinces me that while practically exhaustless time has been and is available for the discussion of dental problems, all the way from technic to economics, too little time has been devoted to the consideration of what the private practitioner can and should do, not as an operator but as a teacher, in leading the lay public toward better teeth and healthier mouths. It is high time for the dental profession as a whole to undertake the education of the public in things dental rather than leaving that education in the hands of tooth paste manufacturers whose altruism is apt to be subservient to graphs on profit and loss.

In discussing the relation of the private practitioner to public health, I wish to show why there is such a relation, how and what the practitioner should

*Read before the District of Columbia Dental Society, Nov. 10, 1931.

†Chief, Division of Oral Hygiene, Maryland State Department of Health.

teach and, finally, the results to be expected from the dentist's participation in public health work.

All of you know the figures obtained by fact-finding statisticians on the scope of present-day dental service. We are told that we are serving a mere 15 or 20 per cent of the population. Theoretically, at least, but a small minority of people appreciate the importance to themselves and their loved ones of mouth health. We knew that importance. Admitting the potential economic factor of the ignorant 80 per cent being instructed in the value of healthy mouths, is not a profession derelict in its duty if it does not attempt, for the sake of the public weal, to enlighten those who do not realize that importance? Biblically speaking, are we to "hide our light under a bushel" or are we to "be a light to lighten the multitude"?

You are doubtless familiar with the often quoted prophecy of Charles E. Mayo, "The next great step in public health will be made by the dental profession." Did he mean that by treating 20 per cent of the population, we would materially contribute to general public health? Of course not. What he did mean, I believe, was that it is incumbent on us as a profession to interest lay people in groups and individually, young and old, rich and poor, in those pertinent facts of which we are in possession.

The task of lay education is not one of a day or a year. It is endless. You may be thinking it utterly hopeless. But think, too, what may be done by the 50,000 dentists in the United States. Suppose each dentist each year reaches 100 people who have not previously realized the importance of mouth health: 5,000,000 people will be reached annually. Nor can one number the people who, through contact with the 5,000,000, will receive some word regarding oral hygiene. Is the education of millions of people to be sneered at?

But how many dentists are carrying on any such educational programs? We will agree that the number is pitifully small. How many dentists try to teach their own patients the facts of mouth hygiene? How many dentists consider health as a causative factor in mouth conditions or bad mouth conditions as the cause of general ill health? I recently heard Russell W. Bunting,[1] of the University of Michigan, make the statement that "to the dental student, the mouth is purely a repository for the placement of certain reconstructions for the obtaining of credits in the course." Is this attitude always changed when the student graduates? Would it not be wise, if possible, to so change dental education that students are not merely given facts and theories but are also taught to apply them with the constantly recurrent thought of the individual's health? Enough cannot be said of the skill and art of modern dentistry, but until that skill and knowledge are applied to preventive dentistry and to the education of the laity in regard to mouth health, our profession will not reach its highest development.

I realize the enormity of the problem; but, with the realization, I insist that we must start attacking it, although we may only scratch its surface in our first efforts. But in so great a task, merely scratching the surface is no mean accomplishment.

How and what are we to teach? Anyone thinking of giving lay instruction must consider this question carefully. If dentists attempt it, they must take care to translate technical language into easily understood terms. I have heard

1. Proc. Am. Ass'n Dent. Schools, p. 357.

men, in talking to lay groups, use words totally meaningless to the audience. What may seem fairly simple nomenclature to a dentist may prove too technical for a layman. It is almost superfluous to say that the instruction should be based upon actual facts, not fads.

Many dentists are not teachers. Probably most of us are not. It may be that we will have to refer some of our educational work to persons trained in interpreting health facts to lay groups. It may be necessary to use hygienists, nurses or school teachers, according to the group to be reached. But if so, the interpreters must be properly trained, and that duty is ours. School hygiene textbooks need some revision dentally. The present textbooks are certainly inadequate as regards oral hygiene.

One must not burden a layman with too many details. Broad generalities are better except in talking to groups that are interested in details. Clarity of thought and expression are primary requisites in avoiding misconstruction and misunderstandings. This is true of the written or spoken word as well as of visual methods of instruction.

Again, one must also be careful as to how emphasis is placed if he wishes to avoid being misunderstood. Let me give an illustration: Several times each year, I am called on to write a press bulletin outlining some important phase of dental health. These bulletins are published in numerous papers throughout Maryland and are, supposedly, read by thousands. Among the readers are persons from every stratum or class. Accordingly, one must follow the newspaper dictum of writing so as to be understood by a 12-year-old, at the same time avoiding insulting the intelligence of more mature minds.

In these bulletins, constant attention is called to three factors in mouth health, namely diet, early dental care and cleanliness. All three are always mentioned, in order not to leave an impression that one is more or less important than the others.

One such bulletin was prepared dwelling at considerable length on the relation and importance of diet to the teeth. Prenatal and postnatal diet, calcium salts and vitamins were mentioned. Because I did not wish to infer that diet is a 100 per cent safeguard against tooth troubles, a few lines were added on cleanliness and regular dental examination; but, primarily, the bulletin was intended to stress the value of a proper diet.

The bulletin was sent out. After publication, we receive copies of various papers containing our articles. Imagine my surprise—it would have been indignation had I not realized that my written words perhaps were to blame—when one paper, under startling headlines, announced, "State Department of Health official says cleanliness greatest factor in safeguarding mouth health."

If the written word is subject to such misconstruction, think how much more so is the spoken word. The "how" of teaching the laity, then, calls for simplicity, clarity and proper emphasis, with strict regard to facts in every instance.

One thing to be avoided is overemphasis of facts dealing with the specialties of dentistry. The pedodontist must not preach mouth health for children alone. The periodontist must not forget other phases of dentistry in his zeal to instruct regarding the peridental tissues. The orthodontist must remember that there are other mouth evils besides crooked arches and malocclusion. And a general practitioner whose greatest interest is prophylaxis must not neglect to mention

other important factors in mouth health.

It is not my province to specify in this address what shall be taught. I can but suggest the things that I think may well be emphasized and outline what I try to "put across" in talks before lay groups.

First, diet. Every dentist should know enough of dietetics to talk of it intelligently. He need not know the caloric content, every vitamin present or the carbohydrate and protein rating of all foods. But he should know how and where to find such facts. He should know what vitamins are and what they do, especially in dentition. He should know that calcium and phosphorus are essential to good tooth structure; and he should know the body's use of protein and carbohydrates and what deleterious effect an excess of the latter may have on the teeth.

But the dentist is not the person to instruct the average lay audience in the technical aspects of nutrition, and by the average I mean a group of persons coming from every stratum of the unreached 80 per cent of the population. To attempt to do so would be as inappropriate as to endeavor to interest them in pulp nodules, hypercementosis and periodontoclasia. What should be emphasized is that mineral salts and vitamins are needed to help make good teeth; that certain foods: milk, cereals, leafy green vegetables and fruit juices, contain such salts and vitamins, and that vitamins are strange unseen things that play an important part in the body's development. The merits of cod liver oil, ergosterol and sunlight should, of course, be mentioned.

Emphasis should also be placed on the importance of prenatal diet and the reason given for this emphasis. Likewise, the need of dietary care during the period of breast nursing, infancy, childhood, adolescence and mature life should be stressed.

I know of nothing more disastrous than to specify what must and what must not be eaten. The average audience always feels that you would deprive them of all pleasant foods and foist spinach on them. The unqualified recommendation of specific diets to miscellaneous groups is as silly and as harmful as are the pronouncements of a purveyor of patent medicine panaceas. For specific needs in a dietary, refer the individual to a physician or to your own office, where, after careful study, you can give some adequate advice.

Next comes early and regular dental care. Not being in private practice, it may seem that I am in a better position to advise regular visits to a dental office than is a private practitioner. But certainly any group that calls on and accepts a dentist as a speaker will not impugn his motives if he suggests seasonal dental examinations.

Here, I should like to interpolate the statement that there are, I believe, more imputations of one's motives coming from fellow practitioners who think every appearance in public or print is an attempt at self-aggrandizement. Doubtless, there are many so-called ethical dentists who seek opportunities to flaunt their name and business (theirs is not a profession) in public, but they are no more obnoxious than the hyperethical hypocritical practitioner who casts doubt on the motives of sincere men who, with no thought of self, are trying to promote the welfare of mankind and lift our profession to its rightful high plane.

But to go on: Point out the need of early dental care. Explain that, in spite of good diet, teeth can erupt with defects. Explode that age-old fallacy that it is not worth while to correct defects

in deciduous teeth. Get in some early facts about the "six year" molar being a permanent and not a "baby" tooth. Tell parents to take their 3-year-old children to a dentist and thereafter at least twice yearly or as often as the dentist suggests. Tell why the slogan "Never let your teeth ache" is wise. Mention the possible results of thumb, finger and lip sucking. Do you know why a baby sucks a thumb? Do you know that it may be due to either hunger or to overfeeding, but that, if uncorrected, it may become a habit?

Tell your audience that dental decay —caries is a difficult word—is a disease. Many people do not consider it as such. Do not leave them with the old idea that tooth decay ends with mere toothaches or extraction. Explain the possibility of general infection from bad teeth, of heart lesions, rheumatism and arthritis.

In talking to children, the best results are not to be had by threatening them with the dire consequences of tooth neglect. Boys and girls do not, or should not, readily become frightened. Rather, tell the girls how their teeth make for beauty. Tell the boys that Lindbergh might not have succeeded had he had bad teeth or that Walter Johnson probably would not have won that World Series game had he been suffering with toothache. Surely that is not tampering with the truth. Tell what dental care will do instead of stressing the bad results of dental neglect.

Finally, in my talks, I stress the importance of cleanliness. In talking to you this phase of the subject is broached with less reluctance than it is in an address to lay groups. I always fear that they will misinterpret me and quote me as saying tooth brushing is unimportant. Of course, I say no such thing.

What I do say and think is that tooth cleanliness cannot be depended on as a 100 per cent guarantee against dental ailments. I believe that the dentifrice and toothbrush propaganda in advertisements does a great deal of good, but some harm is done in offering various products as panaceas for dental ailments. I explain the fallacy contained in the slogan "A clean tooth never decays." I suggest that they will be wise to take their dentist's advice relative to their tooth brushing rather than to accept the questionable altruism of commercial product advertising.

In addressing a lay audience, or in instructing groups, we should stress cleanliness as an important aid in preventing decay, as a matter of common decency and as a factor in general health. I tell them that a toothbrush or toothpaste is no better than the manner in which it is used. I refer them to you private practitioners regarding what brush, what paste or powder and what method they should use. Do you tell them when they come to you?

In a talk on general mouth health, do not tell them how to brush the teeth. There isn't time, and probably no three people would have the same understanding of your instructions. Leave that instruction for individuals rather than groups. With groups, I am not so much interested in how they brush the teeth, except to insist that they spend more than the usual thirty seconds allotted to it, as in getting them to do it regularly so that the care of the mouth will constantly be before them.

That reveals the real purpose of lay talks: to make people *think* of their mouths and teeth, and to stimulate them to action. It also suggests the results which I believe are to be derived from such education.

As far as diet is concerned, if the

knowledge we have now is applied by the present generation, it will mean better and stronger teeth for the next. But tremendous improvement can also be made in the mouth conditions of adults and in the deplorable conditions existing in the mouths of today's children, if education along proper lines is made more general.

It does not take long to see some results. I was privileged to work for several years with a group putting on a five-year program in child health in Fargo, N. D. During my last year's connection with the work, I was examining hundreds of children who had been born and reared to a school age under a continual flood of advice in regard to correct diet, proper exercise and general healthful conditions. Those children showed marked improvement in mouth conditions; so marked as to prove definitely the importance of diet.

Fargo school children were taught health in an interesting manner. My clinic was in a school building. Through open doors, I one day heard the following conversation in a classroom where an arithmetic lesson was under way: "You have twenty baby teeth and thirty-two permanent teeth. How many teeth do you have in all." A chorus answered "Fifty-two." "All right. Now if you don't take care of your teeth and five decay so badly that they are making you unhealthy and have to be extracted, how many teeth will you have left?" And again the answer, "Forty-seven."

Or perhaps it was a history lesson. The children learned of the horrors of the winter at Valley Forge. And they learned, too, that one of its horrors was scurvy, a disease manfesting itself in such and such a way and due to a lack of proper food; a lack of food containing vitamins.

It may sound simple. But Fargo children knew the importance of health habits. So the simplicity—if it is that—of the method of instructoin need not be considered.

Preaching early and regular dental office visits will result in substituting preventive operative dentistry for restorative operative dentistry. In that regard, I have a request that I always make before a group of dentists. General practitioners have an opportunity to promote preventive dentistry—which means public health—in a way that does not demand speech making or lay education; that is, by caring for the children that come to their offices. Frankly, the profession as a whole has sidestepped the responsibility. I know the excuses—the question of economics, the fear of an upset morale and the disturbance a recalcitrant child can cause; but, with the possible exception of the economic factor, these are not honest excuses.

All children are not bad patients. Many who are could blame their badness on ignorant parents and misunderstanding or careless dentists. Children from 3 to 6 years of age in the hands of a conscientious dentist whose art, skill and thoroughness are tempered by kindliness toward a child's feelings can be the best patients one could desire. Good patients from 3 to 6, they will be the best patients from 6 to 60.

Giving cleanliness, *proper* cleanliness, the rightful emphasis will result in reducing tooth decay and, what I believe more important, it will make "mouth health conscious" a fact instead of a phrase.

CONCLUSION

How will the profession benefit by all this education of the laity? In two ways: First, by actually increasing the number demanding dental service. Only two

things send people to the dentist: the toothache and thinking of their teeth. I believe that every dental health talk, every dental health poster, every dental health film results in dental office visits that otherwise might not have been made. A school dental examination results in unknown numbers of children visiting their dentists; and by going home and telling of the examination, those children cause numberless adults to "think about their teeth" and visit a dental office.

Secondly, the private practitioner will benefit by that glow of satisfaction that comes from a task well done. I know as you do the sense of good feeling that can be derived from inserting a good gold foil, inlay or amalgam; from making a beautifully finished and fitting bridge or denture; from the alleviation of an all night toothache. But when we can look into mouths of children and see strong, well formed, decay-resisting clean teeth and healthy mouths and know that some credit is due us because we have taught the way to that healthy condition, the private practitioner will derive the greatest satisfaction obtainable from his part in public health work.

An enlightened public will find a dental profession ready to serve it with an art, skill and knowledge second to none in the healing professions. As the public comes to demand such service, the need for recruits to the dental profession will grow. Then and not till then will I consider "dentistry at the cross-roads." And it will be a cross-road gathering place for an enlarged profession to move on together toward greater professional achievements.

SCHOOL DENTISTS

By J. M. WISAN*, D.D.S., Elizabeth, N. J.

ARE we, the school dentists, being maligned? Are the rumors that are being spread about us based on facts? A lawyer considering a libel suit weighs very carefully two points. Are the rumors harmful? Are the damaging statements true?

Shall we start suit against the gossipers? Perhaps the better course to follow would be to consider the accusations fairly, honestly and frankly.

I have often wished that I could meet with a group of school dentists when masks are off and reserve is missing; when we could converse, one with the other, freely and unreservedly. With this in mind, I shall write my thoughts imagining that my reader has donned his smoking jacket, has lighted his favorite cigar or pipe and has settled himself comfortably in his chair. In this relaxed position, I am certain that he will confer with me without restraint or reservation.

It has been said that school dentists are not prompt in their attendance. If they are due at 9 a.m., they arrive considerably later, disregarding the fact that nurses and children are waiting for them.

*Chairman, Council on Mouth Hygiene, New Jersey State Dental Society.

Many nurses lose interest in the work and cease to send patients to the clinic because of a dentist's tardiness.

I have heard school superintendents bewail the lack of cooperation shown by the dentist doing school work. The school official insists that the dental clinic is a part and parcel of the entire health program, and he happens to be correct. One of the handicaps that hindered the progress of dentistry for many years was the almost universal practice of considering dental disease from the point of view of the tooth only. Fortunately, recent research study and experimentation has emphasized to the dental and medical professions that we, as dentists, are not dealing with a local, separate or individual issue; but that our conception must be more inclusive; that our treatments must take into consideration the body as a whole. Let us not be guilty, therefore, of this charge. Let us remember that we are part of a great educational system teaching the children the magnificent art—how to live.

Several members of boards of education have threatened to vote against the hiring of school dentists, because their experience has been that a dentist will accept a position, keep it until he has become well established in his practice and then resign. My observations lead me to the conclusion that a dentist cannot establish a scientific and fact-finding dental program in less than five years, and when he has established his system, he is the only man who can carry out the program.

Undoubtedly, many dentists resign their school positions because of the low salaries offered. I often wish that I had sufficient powers of persuasion to show how dental work may be made an avocation and a pleasure. Dentists considering school operations as a public duty would not be so likely to emphasize the salary unnecessarily. If such a condition should come to pass, dentistry of the future need not be disturbed about its standing or prestige, or sufficiency of patients.

If more members of our profession were aware of the importance of public health work and would participate more freely in this form of public service, panel dentistry would be an impossibility.

Scoffers point their fingers at us and say that we are interested only in filling and pulling teeth, that we take no interest in promulgating a preventive program. If we can answer the following questions in the affirmative, we shall be declared "not guilty" by the jury of our conscience: Do we supply teachers and pupils with all the elemental facts regarding prevention, daily hygiene, choice of suitable foods, importance of early and regular dental treatment and of systemic health and correct mental attitudes? Do we emphasize to teachers the value of morning inspection to assure the daily cleaning of the pupils' teeth? Do we diligently watch for the precarious fissure and treat it properly?

Critics of school clinics maintain that the work performed in the school clinics generally is faulty and lacking in thoroughness as compared with operations performed in the private office; that the school dentist seeks a record for quantity and neglects the quality; that mouths are not carefully examined; that teeth are extracted without an anesthetic; that fillings are placed over areas of decay; that fillings are not properly polished, and that cement fillings are inserted for permanent restoration of lost tooth structure. Are we guilty of such practices?

I suppose that in the clinic which is not supervised by a capable member of the dental profession, such faulty opera-

tions might be found. We will always have among us some men who, lacking in sense of duty, will try to "get by" with a lackadaisical attitude. I know of no condition that would retard the progress of school clinics more than poor results of operations performed there. Perhaps it would be better to prevent the possibility of such men functioning by providing efficient professional supervision. I believe that this is a solution for many of the evils of the school dental clinics. If we should say to the officials of our community that we would welcome supervision by a capable executive (a dentist), school dental clinics would be immeasurably improved.

Men who have a genius for method and system state that school dentists rarely have a definite program, but perform their daily tasks in a more or less haphazard fashion. Do we set up our objectives and work out a method of accomplishing them? Do we study the general aspects of the problem of preserving children's teeth and, from this vantage point, map out a definite and complete plan of attack?

Do we start our work from the so-called base line by examining the mouths of all the pupils so that we can realize the condition of their teeth? Does our community rank with the average in 95 per cent of its children with defective teeth, as announced by the White House Conference on Child Health? Can we answer this question definitely?

After the inspection, do we encourage the children to go to their family dentist for treatment? Can we tell how many follow our advice? Have we arranged a definite routine so that the more important cases receive attention? Do we keep accurate records in the clinic? Can we determine, after the year's work is over, to what extent we have reduced the percentage of children requiring dental attention? Do we continue the annual examination of the pupil's teeth to determine the progress of our program? Do we report our findings to the Board of Education, and to the newspapers?

Complaints come in that children going to school clinics are treated as groups rather than as individuals. In answering this charge, many questions arise which we should ask ourselves. Do we study each child? Do we try to understand his characteristics? Do we consider the feelings of the pupils? Do we take every precaution to make our operations as painless as possible? Do we use a surface anesthesia before inserting the needle? Do we use sharp burs with slight pressure? Do we work slowly and deliberately? When using local anesthesia, do we wait for the injection to take effect? If the child fears the dental operation, do we make an attempt to ease his apprehension? Are we patient, understanding and tolerant with the difficult children? Have we made a study of child psychology? Do we attempt to make the boys and girls like us? Do we joke with them, or tell them stories? Do children squeeze our hand and say, "I like you, Doctor"? Do we realize that we are building up a lifetime attitude of fear for the dentist if we disregard the advice of the child psychologist? Do we consider that if we treat the child with gentleness and kindness, we are creating in him a spirit of cooperation that will cause him to care properly for his teeth and visit the dentist in later years with a minimum of apprehension?

Perhaps these questions that I have submitted to you may characterize me as an extremist, a faddist, or as one who places too much emphasis on the school clinic. Before drawing this conclusion, please consider the report of the White

House Conference, and also the report of Dr. Delabarre of Massachusetts, who found an average of eight cavities per child. Be mindful of the fact that dental disease outnumbers all other child abnormalities combined, and that dental decay has increased to such a dangerous degree that the only practical method of preserving the teeth of children is early and regular treatment of all children. The school clinic is the only means of providing necessary dental attention to indigent children.

If it could be proved that there is another way of accomplishing this purpose, I would admit that it might not be necessary to have the school clinic function with such thoroughness and completeness. Until we can substitute a better method, we are duty bound to make the school clinic the counterpart of the higher type dental office, serving all children that come under our care with diligence and thoroughness.

I prefer to view the dentist, and more particularly the practitioner who treats children, not as the craftsman who mechanically works at his bench, but as the artist who carries out the preformance of his productions with technical skill fashioned and molded by vision, imagination and idealism. The words of Henri, describing the artist, express my conception of the real school dentist: "He disturbs, upsets, enlightens. Where those who are not artists are trying to close the book, he opens it, shows there are still more pages possible."

"Oh yes," you say, "those ideals are remarkable and worthy, but impossible to accomplish when one has to contend with a school superintendent who is not in agreement with the plan of including the dental clinic in the school system, or if a board of education will not furnish the necessary funds." It must be admitted that, in many localities, conditions are against the dentist. He may be handicapped by lack of cooperation in the homes or the teachers may refuse to work with him. Economic conditions, a lack of funds in the city or county treasury, also may make it impossible to establish a complete dental program in the schools.

Where such conditions prevail, there is but one answer: educational propaganda to stimulate a desire for an efficient school dental clinic. The individual dentist, as well as the dental organization, should organize an extensive program including newspaper articles, letters to the controlling officials and talks before representative organizations, all emphasizing the need and value of preventive and restorative dental treatment for the children.

An excellent means of convincing the public of the urgent necessity for the extensive dental program, is a thorough examination (preferably Walker No. 1 or No. 2) and a report of the findings. When they are brought face to face with the fact that a vast majority of their children are badly in need of dental treatment, they will exert all the influence necessary for the institution of a really efficient dental clinic in the school.

Let me warn you of one danger. If you would undertake such a task as I have outlined, or if you do make ambitious and intensive efforts to supply teachers and pupils with all the necessary information to aid them in the preservation of their teeth, you undoubtedly will be accused by some of your fellow practitioners of being a publicity seeker. They will say that you are using your position to help build your practice. How blind they are! Constant work in their small four-walled offices has brought about this myopia. Not having participated in public health work, they are not

cognizant of the real conditions in the mouths of the poor children, and some of the rich ones who never come to their office. Furthermore, they are not aware of the fact that a comprehensive dental program in the schools increases respect for the dental profession and educates the future citizens to the necessity of dental treatment.

When I hear of such criticism, I want to quote that passage, "Ye bite and devour one another." I do wonder, at times, if a campaign to educate the dentist is not in order. Perhaps the state dental societies should attempt to organize campaigns to teach the average dentist the value of early and regular attention to children's teeth, the value of preventive education and the needs of the public health.

By this time, your cigar is well spent and the hour is getting late. So I shall close this, my monolog, with words of Oscar Wilde: "It is criticism that recognizing no position as final and refusing to bind itself by the shallow shibboleths of any sect or school, creates that serene philosophic temper which loves the truth for its own sake and loves it not the less because it knows it to be unattainable."

THE "SELLS HEALTH-O CIRCUS"

The Bureau of Public Relations is pleased to announce that it has purchased a complete set of equipment necessary to the presentation of that excellent health play, the Sells Health-O Circus. This equipment is now available for the use of those desiring to stage the "Circus" as a part of their community dental health educational activities. It may be borrowed simply by paying the shipping charges both ways.

Because of an expected heavy demand, it is essential that arrangements for the use of this equipment be made well in advance of the time when it is to be used. It must also be remembered that in order to assure constant and distributed use, this equipment should be requested only for a period long enough to take care of a maximum of two final rehearsals and the actual presentation of the play.

It may be that many of our readers are not familiar with the Sells Health-O Circus. In such instances, the Bureau will be pleased to send the necessary information on request. Address all inquiries to the Bureau of Public Relations, American Dental Association, 212 East Superior St., Chicago Ill.

MISCELLANY

BOOK REVIEWS

Index of the Periodical Dental Literature. **Published in the English Language, Including Eighty-Three Publications in England, Canada and the United States for Five Years, 1901-1905. A Classified Subject Index on the Plan of the Dewey Decimal Classification. An Alphabetical Author Index. A List of Dental Books Reviewed During the Same Period. Compiled by Arthur D. Black, A.M., M.D., D.D.S., Sc.D., Dean, Northwestern University Dental School. Published by the Dental Index Bureau, 381 Linwood Avenue, Buffalo, New York. Henry Kimpton, 263 High Holborn, London, England. Under the auspices of the American Association of Dental Colleges, American Dental Association, Research Commission of the American Dental Association, British Dental Association, Canadian Dental Association, New Zealand Dental Association, and Society of Dental Science of New South Wales. 1931. Administrative Board of the Dental Index Bureau, H. E. Friesell, Chairman, Pittsburgh, Pa.; Arthur D. Black, Editor, Chicago, Ill.; Abram Hoffman, Secretary-Treasurer, Buffalo, N. Y.; William Bebb, Librarian, Chicago, Ill. Price $6.00 in the United States and Canada and $6.50 in foreign countries.**

The fact that nine volumes of this stu-

pendous work have already been published and have previously been reviewed renders it unnecessary to make any detailed reference to it at this time. It would seem that the publication of this Index should stimulate the members of the profession to enter more heartily into the preparation of papers, and to be more particular about the character of their work in this regard when they realize that every published paper is made a matter of permanent record through the medium of the Index. At any time in all the years to come, an author may have access to accurate information concerning every paper that he has published in our dental periodical literature, and this should act as a stimulus not only to present papers but to prepare them as carefully as possible. The value of this Index is without question, and the editor and publisher are to be congratulated on its publication.

Dental Surgery and Pathology. By J. F. Colyer, K.B.E., F.R.C.S., L.D.S., Consulting Dental Surgeon to Charing Cross Hospital, Formerly Examiner in Dental Surgery, Royal College of Surgeons of England, and Evelyn Sprawson, M.C., M.R.C.S., L.R.C.P., L.D.S., Dental Surgeon and Lecturer on Dental Surgery and Pathology to the London Hospital, Examiner in Dental Surgery and Pathology, University of London, Formerly Examiner in Dental Surgery, Royal College of Surgeons of England. Sixth Edition with Plates and Illustrations. 908 pages. Price, $12.50. Published by Longmans, Green and Co., London, New York and Toronto.

This book has involved an immense amount of work, and there is a great profusion of illustrative material; in all, 860 cuts. The subject matter covers a wide range, and embraces the entire field of this interesting subject, but that such a topic as the treatment of pulpless teeth (the authors call them "dead" teeth) comprises only about eight pages would hardly seem adequate consideration for a subject of this importance. The diseases of the supporting structures of the teeth have received more satisfactory and comprehensive treatment, as well as the "Removal of Teeth," on which there is a chapter. Of particular interest is the consideration of odontomes, which forms one of the outstanding chapters of the book, and is well worth reading and studying. "Abnormalities in position of the teeth" come in for much attention, and the various types of abnormalities are extensively illustrated by numerous models. As has been intimated, the illustrative material forms a very prominent feature of the book, and the authors and publishers are to be congratulated on the character of this part of their work.

Health Protection for the Preschool Child: A National Survey of the Use of Preventive Medical and Dental Service for Children Under Six. A report to the Section on Medical Service. By George Truman Palmer, Dr. P. H., Chairman, Subcommittee on Statistics, Mahew Derryberry, Research Assistant, Philip Van Ingen, M.D., Chairman, Committee on Medical Care for Children. White House Conference on Child Health and Protection. 275 pages. Price, $2.50. Published by the Century Company, New York and London.

This is a book that should be in the hands of everyone who is interested in the bringing up of children. More and more, the fact must be stressed that the earlier we give intelligent attention to children, the better it is for their future, and one of the most significant considerations has relation to health. The present concentration on the study of health in children must bear abundant fruit in the days to come.

Of major interest to the dentist are those chapters dealing with dental health examinations. A very comprehensive study has been made in this regard, and while we cannot go thoroughly into its analysis at this time, we commend it to the attention of every student of preschool children.

The book is a mine of statistics which may be studied to great advantage, and reference may be made to its pages in any future study of the subject.

CORRESPONDENCE

"The One Thing Lacking"

To the Editor:

This article is inspired by reading a contribution in the September Journal entitled "What Is the One Thing Needful?" by James A. Brady.

"Dental ethics" and "dental economics" are the two subjects which have produced more discussion and controversy than any others affecting our profession. Our viewpoint as to our relation to each other and to the public has been either distorted or lacking in the one thing necessary to have made our service a complete success not only to the public but also to ourselves.

Let us go back to our college days and our

early practice and recall our hopes and aspirations. Were they not all based on one determination: to build a large and flourishing practice and accumulate as large an amount of money and material goods as possible? Did we not diligently seek to ascertain the fee charged by Doctor So and So and mentally determine to attain that same fee or a larger one as soon as possible?

How many of us, as we stepped into our newly equipped offices, were overwhelmed with a consuming ambition to make a better plate or insert a better filling than had ever been made before? What proportion of our thought was devoted to a spirit to give?

Answer these questions for yourselves, but be honest.

Taking in the vast scope of the activities of the dental profession over the period of years covering our connection with it, what proportion of our time and thought and consideration has been devoted to the giving of ourselves, free from selfish ends?

Have we individually, in our daily practices, endeavored to fit our fee to the ability of each patient to pay? Have we not, to the contrary, established a fee (raising it from time to time) and insisted that it be met? If any variation has been made, has it not been upward rather than downward? Have we as individuals or as a profession endeavored conscientiously to devise ways and means to reduce the cost of dental service to the public?

Hasn't it occurred to you, my fellow practitioner, that the fundamental cause of this so-called world wide depression has been the spirit of greed as manifested by the world at large? Think it over.

The attitude of individuals and nations has been that of attainment and accumulation. The desire to be rich has completely enveloped every other consideration. Wars have been waged and peoples destroyed that one country might become richer and more powerful. Individuals have resorted to inconceivable measures in order that they might pile up fortunes, and have devoted their later days trying to give them away. If an effort was made to reduce costs, it was not that the consuming public might benefit thereby, but only that dividends might become larger. A crash was inevitable. Likewise, a crash is coming in our professional life (or is already here) if we do not revise our methods and obtain a new point of view.

Have you observed, readers of dental magazines, how utterly devoid of any spiritual mention our dental literature is? This seems strange. Is it possible that the dental profession is of the earth earthy? Are we as a class devoid of God-given impulses?

Surely not; but it does seem that we are most reluctant to give voice to the God-given attributes with which we are created.

Readers, "the one thing lacking" in our profession is the manifestation of the God spirit.

Let us determine to give: give the best there is in us: give freely and generously, and we need have no fear of "panel dentistry" or anything else. Our offices will be full and our pocket books also and suffering humanity will rise up and call us blessed.

ARTHUR M. FLOOD,
240 Stockton Street,
San Francisco, Calif.

RESOLUTION ON ADVERTISING

To the Editor:

It might be of interest to some of the readers to know that the following resolution was passed at the third National Convention of the Federated Guilds of St. Apollonia, held in Buffalo, during the week of November 8.

The Guild is a group of Catholic dentists with a three-fold purpose: strengthening of their religious growth, professional advancement and charity in line with their profession.

"In view of the fact that the American Dental Association has an ethical code of advertising and that it has been brought to the attention of this Convention that very many Catholic papers and periodicals are opening their pages to unethical commercial advertising, the Convention hereby resolves to memorialize the Catholic Press Association about the evil, and each local guild pledges itself to an active campaign, according to local conditions, to help toward the elimination of any abuses called to its attention."

This resolution was sent to the National Catholic Welfare Council and through their news service distributed to all the Catholic periodicals in the country.

JOSEPH J. STAHL,
Secretary of Federated Guilds,
1 Hanson Place, Brooklyn, N. Y.

SOCIAL INSURANCE

To the Editor:

For a number of years, I have been convinced that social insurance is one of the most important problems confronting the civi-

lized nations of the world and that compulsory health insurance, a branch of social insurance, is the biggest quasimedical question before the medical profession of this country today. Acting on this belief, I have prepared six short articles which consider the problem from its political and economic effects on society in general. If these articles are well received by the editors, I intend to write six more, the material for which I have already collected. The latter articles will consider the effects of such legislation on medical practice.

EDWARD H. OCHSNER,
2155 Cleveland Ave.,
Chicago, Ill.

Dec. 15, 1931.

[Ed. note.—The first article in this series is appended.]

THE GENESIS OF SOCIAL INSURANCE

Social insurance is the hybrid offspring of impracticable sentimentalism and political expediency. It is an epidemic disease, first observed in Germany about fifty years ago, which has gradually spread and infected a considerable number of the nations of the earth and has now arrived at our very doors. Unless we succeed in establishing a rigorous quarantine of enlightened public opinion, it will surely gain a foothold in this country in the not distant future.

Social insurance consists of the following subdivisions or parts: compulsory health insurance, old age pensions, widows' and orphans' pensions and unemployment pensions or doles. In none of the countries were they all adopted at one time. Germany adopted compulsory health insurance in 1883, and has adopted all of the other forms since that time. Austria adopted compulsory health insurance in 1888; Hungary, in 1891. England adopted old age pensions first; compulsory health insurance next, in 1911, and the others subsequently. In this country, some of the states have adopted old age pensions and some widows' and orphans' pensions, but so far, none have adopted compulsory health insurance; for which negative blessing let us raise our voices in thanksgiving.

When the scientific physician is confronted with the problems presented by a new patient, he meets the situation in the following manner: he obtains a complete family and personal history in order to ascertain if possible the causes which have brought about the condition; and, by his physical examination and laboratory investigations, he finds out what variations from the normal have taken place. After all this, he is in a position to advise and institute the proper treatment. Let us follow the same course in the study of this problem.

During the late seventies, a number of German parlor socialists conceived the idea that the state make itself responsible for the medical care of its workers. The sentiment in favor of compulsory health insurance grew rapidly among the workers, and Bismarck, expressing serious doubts as to the soundness of such a measure, yet feeling that something had to be done in order to appease the clamor of the proletariat and the alarming growth of socialism, adopted social insurance as a government measure and had a bill drafted and enacted into law.

In England, national insurance, as it is called there, had a slightly different setting but substantially the same background. In 1910, David Lloyd George, in order to strengthen himself politically, decided that such legislation would be opportune. Not being able to speak German, he gathered about himself several interpreters, hied himself to Germany and, after interviewing the well-paid heads of the German system, and having been wined and dined and lionized for two weeks or so, he returned to England very enthusiastic about the whole project, had a law drafted, and later secured its passage. In the recent parliamentary election, the Liberty party, of which Lloyd George has been the head for many years, elected just four members to Parliament, or less than 1 per cent of the whole number. So while Lloyd George may have saved his political skin by national insurance in 1911, he certainly lost his hide by it in 1931.

Practically every reform movement attracts to itself a considerable number of well-meaning, emotionally impressionable, impractical, irresponsible, very vociferous individuals, and very often a group, usually the very ones who manage the propaganda and who hope to gain some pecuniary benefit from it. Social insurance is no exception to this general rule.

One of the common characteristics of reformers is that they want a new law passed for every human ill, and when the law is enacted, they either sit back waiting for the millennium to arrive or they rush off looking for new evils to correct by new laws, forgetting to see to it that the law just passed is

being properly enforced, and forgetting at all times that all laws must depend for their enforcement not on supermen but on men often of less than average intelligence and integrity, on politicians and their henchmen, who are quick to see how these usually unsound and loosely drawn laws can be converted to their own advantage.

(The foregoing is what is actually happening in some of the countries where such laws are in operation as future installments will show.)

RESOLUTIONS OF FLORIDA STATE DENTAL SOCIETY ON BOARD OF STOMATOLOGY

WHEREAS, it has come to the attention of the Florida State Dental Society that there has been filed with the State of New York an application for charter for "The American Board of Stomatology" to function as a corporation throughout the United States and Canada "and wherever medical an dental science is practiced," and

WHEREAS, the "purposes" of said Board are such as are already provided for by existing university dental and medical colleges and by state boards of dental and medical examiners which are legally and officially delegated to carry out such functions of maintaining the highest and most up-to-date standards in dental or stomatologic practice, and

WHEREAS, the establishment of such a board will cause confusion among the professions and the public and work hardships by singling out as "superdentists" dentists who possess certificates of this Board, and

WHEREAS, the tendency in dental and medical education has been toward the university standard and away from the "private" or "commercial" standard such as is apparent to result with the establishment of such self-appointed bodies as "The American Board of Stomatology, Inc.," and

WHEREAS, we feel that some if not all of those individuals who have subscribed their names in the petition for the charter of "The American Board of Stomatology, Inc.," have done so in an ill-advised moment and will in time regret, if they have not already regretted, having done so, yet because of our prerogative to protect the professions and the public from harmful legislation and enactments relative to the practice of dentistry and medicine, be it therefore

Resolved, that this Florida State Dental Society at its annual session held at St. Petersburg, Florida, on November 12, 13 and 14 goes on record as opposed to this proposed "Board" and its incorporation and vigorously protests against it, and be it further

Resolved, that a copy of these resolutions be sent to the authorities at Albany, N. Y., to whom the petition was made, to the American Dental Association, the secretary named in the petition, the president of each state dental society and to the medical and dental press.

EDWARD L. THOMPSON
MALCOLM A. SMITH, JR.
FRANK L. ADAMS
Committee.

NEWS

Radio as Medium for Acquainting Public with Aims of Medicine and Dentistry: For the period of a year, the Columbia Broadcasting System has carried over a chain of approximately forty radio stations a series of weekly talks by Howard W. Haggard, M.D., associate professor of applied physiology at Yale University. The title of the series was fixed with a view to attracting the laity: "Devils, Drugs and Doctors." The material was prepared by Dr. Haggard in a popular style, with the average level of the public in mind. The talks were ethical and dignified at all times. The material of the series was historical at times, explanatory at times, analytic at other times, the object being to develop in the radio public greater sympathy with the professions and greater understanding of their achievements, their objectives and their methods. Typical titles among the fifty-two fifteen-minute broadcasts were "Medicine, and Its Place in History," "History of Anesthesia," "Florence Nightingale," "Importance of Diagnosis," "Mothers' Day?" "National Hospital Day," "The Black Death," "Wilhelm Konrad Roentgen," "The Progress of Dentistry," "Medical Innovations," "The Apothecary," "The Industrial Revolution," "Athletics with Safety," "American Dentistry" and "Health and Education." The series of talks was sponsored by the Eastman Kodak Company. No advertising was included in the broadcasts nor any reference to the Eastman Kodak Company except mention of the name of the sponsor.

Boy Scout Week: The Boy Scouts of America will celebrate their twenty-second anniversary Feb. 7-13, 1932. The world scout

population is now more than 2,000,000, and in the United States there are approximately 900,000 scouts. Every dentist who has a boy of scout age should see that the boy joins. It will help our citizenship in the days to come.

DEATHS

Bannister, John K., Lima, Ohio; Ohio College of Dental Surgery, Dental Department of the University of Cincinnati, 1898; died, September 5; aged 55.

Pape, Herman G., Davenport, Iowa; Chicago College of Dental Surgery, 1891; died, November 20; aged 60. Dr. Pape was a great lover of nature and was known as the father of the Davenport park system, as it was largely through his efforts that the park area was increased from 200 to 650 acres.

ANNOUNCEMENTS*

CALENDAR OF MEETINGS

American Dental Association, Buffalo, N. Y., September 12-16.

American Board of Orthodontia, Toronto, Canada, May 16-17.

American Dental Society of Europe, Baden-Baden, Germany, August.

American Society of Orthodontists, Toronto, Canada, May 18-20.

Chicago Dental Society, January 18-21.

Dental Clinic Club of Philadelphia, February 16-19.

Eastern Association of Graduates of Angle School of Orthodontia, Baltimore, Md., January 20.

Eastern Society of Dental Anesthesia, New York City, January 15.

Four State Postgraduate Clinic, Washington, D. C., March 29-31.

Italian Stomatologic Congress, Rome, September.

Kings County Dental Society of Brooklyn, N. Y., February 25-27.

National Society of Denture Prosthetists, Chicago, Ill., January 11-16.

New York Society of Orthodontists, New York City, March 9-10.

Pacific Coast Society of Orthodontists, San Francisco, February 18-20.

Society for Advancement of General Anesthesia in Dentistry, New York City, third Monday in February, April, October and December.

Southwestern Society of Orthodontists, Amarillo, Texas, January 25-27.

Thomas P. Hinman Midwinter Clinic, Atlanta, Ga., March 14-15.

STATE SOCIETIES

District of Columbia, at George Washington University, Washington, D. C., second and fourth Tuesdays in each month from October to June, inclusive.

January

Rhode Island, at Providence (20-21).

February

Minnesota, at St. Paul (24-26).
Pennsylvania, at Lancaster (4-5).

March

Connecticut, at New Haven (March 30-April 1).

April

Kentucky, at Louisville (4-6).
Michigan, at Detroit (11-13).
New Jersey, at Atlantic City (13-15).

May

Maryland, at Baltimore (2-3).
New York, at Albany (11-13).
Texas, at Dallas (17-20).
Virginia and West Virginia, at Winchester, Va. (16-18).

June

Colorado, at Estes Park (20-22).
Wisconsin, at Milwaukee (7-9).

STATE BOARD OF DENTAL EXAMINERS

Delaware, at Wilmington, January 20-21. W. S. P. Combs, Secretary, Middletown.

Kentucky, June 8-11. Robert L. Sprau, Secretary, 970 Baxter Ave., Louisville.

North Dakota, at Jamestown, January 12-15. L. B. McLain, Secretary, Jamestown.

The National Society of Denture Prosthetists will hold its next annual session at the Stevens Hotel, Chicago, January 11-16. Subjects for consideration, esthetics and impressions. Full upper and lower dentures will be constructed for a single patient by three dif-

*Announcements must be received by the fifth day of the month in order to be published in the forthcoming issue of THE JOURNAL.

ferent technics. C. J. Stansbery, Rupert E. Hall and W. H. Wright will demonstrate.

I. L. FURNAS, *Secretary,*
Western Reserve University,
Cleveland, Ohio.

THE AMERICAN BOARD OF ORTHODONTIA*

A meeting of the American Board of Orthodontia will be held at the Royal York Hotel, Toronto, Ontario, May 16-17. Those orthodontists who desire to qualify for a certificate from the Board should secure the necessary application form from the Secretary. The application must be returned to the Secretary, together with any other required credentials, at least sixty days prior to date of examination. In order to expedite the examinations, the Secretary will designate the hour at which applicant may appear before the Board on one of the above mentioned days. Applications filed at the time of Board meeting will have preliminary consideration, so that applicant may be advised of work required for his subsequent examination. Attention is called to the following resolutions adopted by the board: Any person desiring to make application to the board for a certificate shall have been in the exclusive practice of orthodontia for a period of not less than five years or an equivalent to be determined by the board and based upon the following conditions. 1. An instructor in orthodontia in a school satisfactory to the board. 2. An associate in the office of an orthodontist whose standing is satisfactory to the board. It is to be definitely understood that any person at the time of making application for a certificate shall be in the exclusive practice of orthodontia in his own name.

OREN A. OLIVER, *Secretary,*
1101 Medical Arts Bldg.,
Nashville, Tenn.

RHODE ISLAND STATE DENTAL SOCIETY

The annual meeting of the Rhode Island State Dental Society will be held at the Joseph Samuels Dental Clinic for Children, January 20-21, in Providence.

CHARLES J. SMITH, *Secretary,*
146 Westminster St.,
Providence.

*Created by the American Society of Orthodontists, 1929; incorporated, January, 1930, State of Illinois, U. S. A.

THE AMERICAN SOCIETY OF ORTHODONTISTS

The thirty-first annual meeting of the American Society of Orthodontists will be held at the Royal York Hotel, Toronto, Canada, May 18-20. Early reservations will be advisable. Full details of the program will appear at a later date.

CLAUDE R. WOOD, *Sec'y-Treas.,*
608 Medical Arts Bldg.,
Knoxville, Tenn.

TEXAS STATE DENTAL SOCIETY

The Texas State Dental Society will hold its fifty-second annual convention and postgraduate class course at Dallas, May 17-20. An invitation to attend is extended all dentists who are members of the American Dental Association. For information relative to exhibits, write to Sam H. Brock, 1318 Medical Arts Bldg., Dallas.

J. G. FIFE, *Sec'y-Treas.*
Medical Arts Bldg.,
Dallas.

WISCONSIN STATE DENTAL SOCIETY

The sixty-second annual meeting of the Wisconsin State Dental Society will be held at the Schroeder Hotel, Milwaukee, June 7-9.

E. E. PARKINSON, *Secretary,*
104 King St.,
Madison.

KENTUCKY STATE DENTAL ASSOCIATION

The sixty-third annual meeting of the Kentucky State Dental Association will be held in Louisville, April 4-6.

J. H. FULLENWIDER, *Sec'y-Treas.*
Heyburn Bldg.,
Louisville.

KENTUCKY BOARD OF DENTAL EXAMINERS

The next examination of the Kentucky Board of Dental Examiners will be held June 8-11.

ROBERT L. SPRAU, *Secretary,*
970 Baxter Ave.,
Louisville.

NORTH DAKOTA STATE BOARD OF DENTAL EXAMINERS

The North Dakota State Board of Dental Examiners will meet at the Gladstone Hotel,

Jamestown, January 12-15. Applications must be in the hands of the secretary at least ten days before date of meeting. For further information, apply to

L. B. McLAIN, *Secretary,*
Jamestown.

NEW JERSEY STATE DENTAL SOCIETY

The sixty-second annual meeting of the New Jersey State Dental Society will be held in the Hotel Chelsea, Atlantic City, April 13-15. For information on exhibits, address: Earl L. D. Hester, 34 East Palisade Ave., Englewood; clinics: E. J. H. Schneider, 806 Clinton Ave., Newark; general items:

F. K. HEAZELTON, *Secretary,*
223 East Hanover St.,
Trenton.

SOUTHWESTERN SOCIETY OF ORTHODONTISTS

The twelfth annual meeting of the Southwestern Society of Orthodontists will be held at the Herring Hotel, Amarillo, Texas, January 25-27, in conjunction with the meeting of the Panhandle Dental Society. All members of the American Dental Association and of the various orthodontic societies are invited.

CURTIS WILLIAMS, *Secretary,*
Medical Arts Bldg.,
Shreveport, La.

EASTERN SOCIETY OF DENTAL ANESTHESIA

The next meeting of the Eastern Society of Dental Anesthesia will be held at the Barbizon-Plaza, New York City, January 15, at 7:30 p. m., at which time dinner will be served to members and guests. All members of the dental profession and others interested are welcome to the scientific session, at 8:30 p. m. Essayist: Elmer I. McKesson, M. D., Toledo, Ohio.

JOHN B. WOODMAN, *Secretary,*
57 W. 57th St.,
New York City.

PENNSYLVANIA STATE DENTAL MIDWINTER MEETING

The Pennsylvania State Dental Midwinter Meeting will be held in Lancaster, February 4-5, with headquarters at the Hotel Brunswick. Accommodations for visitors may be secured at the Weber, Stevens, Wheatland and Pennsylvania hotels. Among the essayists are: Martin Dewey, F. F. Molt, Waite Cotton, R. O. Schlosser, A. B. Crane and Harold J. Leonard.

HERMAN H. CAWOOD, *Secretary,*
Woolworth Bldg.,
Lancaster.

PACIFIC COAST SOCIETY OF ORTHODONTISTS

The Pacific Coast Society of Orthodontists will hold its next meeting at the Palace Hotel, San Francisco, February 18-20.

F. A. LESLIE, *Secretary,*
Wakefield Bldg.,
Oakland, Calif.

NEW YORK SOCIETY OF ORTHODONTISTS

The eleventh annual meeting of the New York Society of Orthodontists will be held at the Hotel Commodore, New York City, beginning March 9, at 9:30 a. m. and continuing until Thursday afternoon, March 10. All physicians and dentists are invited to attend.

FRANKLIN A. SQUIRES, *Sec'y-Treas.,*
Medical Centre,
White Plains.

EASTERN ASSOCIATION OF GRADUATES OF THE ANGLE SCHOOL OF ORTHODONTIA

The next meeting of the Eastern Association of Graduates of the Angle School of Orthodontia will be held at the Lord Baltimore Hotel, Baltimore, Md., January 30.

B. W. WEINBERGER, *Secretary,*
119 W. 57th St.,
New York City.

THOMAS P. HINMAN MIDWINTER CLINIC

The Thomas P. Hinman Midwinter Clinic, formerly known as the Midwinter Clinic, and which is now a memorial clinic to the late Thomas P. Hinman of Atlanta, Ga., will be held March 14-15 at the Biltmore Hotel, Atlanta.

JOSEPH D. OSBORNE,
604 Doctors Bldg.,
Atlanta, Ga.

PSI OMEGA FORTIETH ANNIVERSARY

In commemoration of the fortieth anniversary of the founding of Psi Omega dental

fraternity in Baltimore, Oriole chapter and Phi Alpha active chapter will hold an anniversary celebration at the Lord Baltimore Hotel, March 5. All Psi Omegans are invited. Make banquet reservations through Alexander H. Paterson, general chairman, Medical Arts Bldg., Baltimore.

JAMES H. FERGUSON, JR., *Chairman,*
Publicity Committee,
Medical Arts Bldg.,
Baltimore.

DENTAL HYGIENISTS ASSOCIATION OF NEW YORK STATE

The Dental Hygienists Association of the State of New York will hold its twelfth annual meeting, May 11-13, at the Centennial Hall, Albany.

EUGENIA SOMMA, *Publicity Chairman,*
1716 Undercliff Ave.,
New York City.

ILLINOIS STATE ORAL HYGIENIST ASSOCIATION

The third annual meeting of the Illinois State Oral Hygienist Association will be held during the Midwinter Clinic of the Chicago Dental Society, at the Stevens Hotel, January 18-21. Registration, Room 412.

DELLA M. SERRITELLA, *Secretary,*
7534 Ellwood Ave.,
Chicago.

TWENTIETH ITALIAN STOMATOLOGIC CONGRESS

The twentieth Italian Stomatologic Congress will be held in Rome at the George Eastman Institute the latter part of September. In view of the fact that the congress will be coincident with the completion of the Institute, the Italian Stomatologic Federation invites foreign colleagues to attend. A committee on foreign participation in the congress has been appointed. Those desiring to be present should apply to Prof. Silvio Palazzi, Milan, Via Cosimo del Fante, 15.

SWINDLING SHOE SALESMAN

Dentists are warned to beware of a swindler representing himself to be a shoe salesman carrying a line of corrective shoes. Drawings are taken of the foot with and without the weight of the body on the arch, and sample shoes of excellent workmanship are shown. In the cases drawn to the attention of THE JOURNAL, the salesman collected $2 for each pair of shoes ordered, and nothing more was heard from him. The firm which he claimed to represent is making an effort to adjust matters to the satisfaction of the swindler's victims, although it is in no way culpable. The swindler is described as about 48 years old, weight about 145; height about 5 feet 8 inches, blue eyes and sandy hair. The informant adds that the swindler "knows shoes."

BOOKS PUBLISHED IN 1931 WORTH BORROWING* OR BUYING† from the LIBRARY BUREAU of the AMERICAN DENTAL ASSOCIATION

212 E. Superior St., Chicago, Ill.

Bogert, L. J.	Nutrition and physical fitness. Philadelphia, Saunders, 1931. $3.00.
Colyer, J. F., & Sprawson, Evelyn	Dental surgery and pathology. New York, Longmans, 1931. $12.50.
Davis, M. M.	Paying your sickness bills. Chicago, University of Chicago Press, 1931. $2.50.
Doxtater, L. W.	Procedures in modern crown and bridge-work. Brooklyn, N. Y., Dental Items of Interest Pub. Co., 1931. $8.00.
Ennis, L. M.	Dental roentgenology. Philadelphia, Lea & Febiger, 1931. $6.50.
Fine, Samuel	Principles and practice of dental assistant. Worcester, Mass., Hamilton Pub. Co. 1931.
Harding, T. S.	Degradation of science. New York, Farrar, 1931. $3.00.
Hildebrand, G. Y.	Studies in masticatory movements of human lower jaw. Berlin. Gruyter, 1931. (No purchase orders accepted.)
Ivy, R. H., & Curtis, Lawrence	Fractures of the jaws. Philadelphia, Lea & Febiger, 1931. $4.50.
Jordan, E. O.	Textbook of general bacteriology. Philadelphia, Saunders, 1931. $6.00.
Lloyd-Williams, E.	Dental mechanics: a manual for students and junior practitioners. London, Bale, 1931. $2.00.
McCoy, J. D.	Applied orthodontia. Philadelphia, Lea & Febiger, 1931. $4.50.
Okumura, Tsurukichi	Present status of dentistry in Japan. Tokyo, Japan, Japan Dental Assn., 1931. (Pamphlet.) (No purchase orders accepted.)
Palmer, G. T., Derryberry, Mahew & Van Ingen, Philip	Health protection for preschool child: national survey of use of preventive medical and dental service for children under six. New York, Century, 1931. $2.50.
Ray, K. W.	Metallurgy for dental students. Philadelphia, Blakiston, 1931. $3.00.
Rukeyser, M. S.	Doctor and his investments. Philadelphia, Blakiston, 1931. $2.50.
Sherman, H. C.	Vitamins. New York, Chemical Catalogue Co., Inc., 1931. $6.00.
Simpson, C. O.	Toothsome topics. St. Louis, University Press, 1931. $2.50.
Toverud, K. U., & Toverud, Guttorm	Studies on the mineral metabolism during pregnancy and lactation and its bearing on the disposition to rickets and dental caries. Uppsala, Almqvist & Wiksells Boktryckeri, A-B, 1931. (Pamphlet.) (No purchase orders accepted.)
Winter, Leo	Textbook of exodontia. St. Louis, Mosby, 1931. $10.00.

For list of books published prior to 1931 see list in the October, 1931, issue of THE JOURNAL.

*Books may be *borrowed* by members of the Association for a period of one week after date of receipt; and if they are not reserved for some one else, the period will be extended on request. A deposit of $2.00 for each volume to be sent at one time should accompany all requests for books. This will be refunded on return of books.

†If you wish to *purchase* books, indicate plainly which books you desire and enclose check with order.

DIRECTORY OF STATE SOCIETY OFFICERS AND DATES OF MEETINGS, 1931-1932

ALABAMA

W. S. Wilson, President.....Fairfield
Frank F. Perry, Secretary-Treasurer.....Montgomery
Date of next meeting: April 12-14, 1932.
Place of next meeting: Birmingham.

ARIZONA

N. C. Lynn, President.....11 E. Pennington St., Tuscon
Paul H. Bennett, Secretary-Treasurer.....130 So. Scott St., Tuscon
Date of next meeting: April, 1932.
Place of next meeting: Tuscon.

ARKANSAS

W. W. Cecil, President.....Harrison
I. M. Sternberg, Secretary-Treasurer..303 Merchants Natl. Bk. Bldg., Fort Smith
Date of next meeting: June 6-8, 1932.
Place of next meeting: Little Rock.

CALIFORNIA (STATE)

Vernon L. Hunt, President.....Minor Theatre Bldg., Arcata
Frederick T. West, Secretary.....2595 Mission St., San Francisco
Howard Dunn, Treasurer.....450 Sutter St., San Francisco
Date of next meeting: April 4-6, 1932.
Place of next meeting: Oakland.

CALIFORNIA (SOUTHERN)

Charles H. Alter, President.....Investment Bldg., Pomona
Charles M. Alderson, Secretary.....1454 Armadale St., Los Angeles
Fred B. Olds, Treasurer.....1152 Roosevelt Bldg., Los Angeles
Date of next meeting: June 13-15, 1932.
Place of next meeting: Los Angeles (Biltmore Hotel).

COLORADO

Lynn D. Mathews, President.....824 Republic Bldg., Denver
Joseph G. Ewers, Secretary.....925 Republic Bldg., Denver
Edward C. Carter, Treasurer.....962 Metropolitan Bldg., Denver
Date of next meeting: June 20-22, 1932.
Place of next meeting: Estes Park (Hotel Stanley).

CONNECTICUT

Stanley E. Armstrong, President.....New Haven
C. W. Vivian, Secretary-Treasurer.....New Britain
Date of next meeting: March 30, April 1, 1932.
Place of next meeting: New Haven (Troup Junior High School).

DELAWARE

Walter O. Stack, President.....Medical Arts Bldg., Wilmington
P. Paul Wintrup, Secretary.....Medical Arts Bldg., Wilmington
P. A. Traynor, Treasurer.....807 Washington St., Wilmington
Date of next meeting: Jan. 13, 1932.
Place of next meeting: Wilmington (Wilmington Country Club).

DISTRICT OF COLUMBIA

Herbert C. Hopkins, President.....826 Conn Ave., Washington
W. M. Simkins, Secretary.....720 Woodward Bldg., Washington
M. F. Finley, Treasurer.....1928 I. St. N. W., Washington
Date of next meeting: Second and fourth Tuesdays in each month.
Place of next meeting: George Washington University Medical School.

FLORIDA

C. C. Stewart, President.....Power & Light Bldg., St. Petersburg
George M. Shields, Secretary-Treasurer.....816-818 Congress Bldg., Miami
Date of next meeting: November, 1932.
Place of next meeting: Hollywood.

GEORGIA

R. F. Sullivan, President.....118 Jones St. E., Savannah
Paul W. Key, Secretary.....Candler Bldg., Atlanta
B. K. Vann, Treasurer.....Candler Bldg., Atlanta
Date of next meeting: June 8-10, 1932.
Place of next meeting: Atlanta.

HAWAII

F. M. Branch, President.....Boston Bldg., Honolulu
J. A. Pekelo, Secretary.....471 So. Beretania St., Honolulu
J. K. S. Chang, Treasurer.....P. O. Box 1582, Honolulu
Place of next meeting:
Date of next meeting:

IDAHO

J. F. Johnston, President.....Twin Falls
R. A. Johnson, Secretary.....Nampa
T. L. Cartney, Treasurer.....Filer
Date of meeting: April, 1932.
Place of next meeting: Twin Falls.

ILLINOIS

Edgar D. Coolidge, President.....25 E. Washington St., Chicago
Ben H. Sherrard, Secretary.....300 Central Trust Bldg., Rock Island
R. H. Daniels, Treasurer.....909 Lehmann Bldg., Peoria
Date of meeting: May 10-12, 1932.
Place of next meeting: Springfield.

INDIANA

W. I. McCullough, President.....903 Hume-Mansur Bldg., Indianapolis
C. L. Byers, Secretary.....2138 North Illinois St., Indianapolis
W. C. Hessler, Treasurer.....312 Ben Hur Bldg., Crawfordsville
Date of next meeting: May 16-18, 1932.
Place of next meeting: Indianapolis (Claypool Hotel).

IOWA

Louis W. Snuggins, President.....1112 Equitable Bldg., Des Moines
John Scholten, Secretary.....810-811 Dows Bldg., Cedar Rapids
Frank Fourt, Treasurer.....Fairfield
Date of next meeting: May 3-5, 1932.
Place of next meeting: Des Moines (Fort Des Moines Hotel).

KANSAS

George E. Burket, President.....Kingman
Fred A. Richmond, Secretary.....Federal Reserve Life Bldg., Kansas City
W. T. Triplett, Treasurer.....Salina
Date of next meeting: April 25-27, 1932.
Place of next meeting: Wichita.

KENTUCKY

Robert L. Sprau, President.....970 Baxter Ave., Louisville
J. H. Fullenwider, Secretary-Treasurer.....1101 Heyburn Bldg., Louisville
Date of next meeting: April 4-6, 1932.
Place of next meeting: Louisville.

LOUISIANA

Charles Sheppard Tuller, President.....Maison Blanche Bldg., New Orleans
Julian S. Bernhard, Secretary.....Medical Arts Bldg., Shreveport
O. J. Ory, Treasurer.....Garyville
Date of next meeting:
Place of next meeting: Monroe.

MAINE

Alton H. Swett, President.....192 State St., Portland
W. D. Taylor, Secretary.....Mechanic Falls
D. S. Roberts, Treasurer.....655 Congress St., Portland
Date of next meeting: June 16-18, 1932.
Place of next meeting: South Poland (Poland Spring House).

MARYLAND

George M. Anderson, President.....831 Park Ave., Baltimore
Walter L. Oggesen, Secretary.....St. Paul and 23rd St., Baltimore
Walter E. Green, Treasurer.....2958 W. North Ave., Baltimore
Date of next meeting: May 2-3, 1932.
Place of next meeting: Baltimore (Southern Hotel).

MASSACHUSETTS

William H. Gilpatric, President.....358 Commonwealth Ave., Boston
Philip E. Adams, Secretary.....236 Newbury St., Boston
Joseph T. Paul, Treasurer.....419 Boylston St., Boston
Date of next meeting: May 2-5, 1932.
Place of next meeting: Boston (Hotel Statler).

MICHIGAN

R. E. Patterson, President.....901 Stroh Bldg., Detroit
William R. Davis, Secretary.....Department of Health, Lansing
E. J. Chamberlin, Treasurer.....519 Ashton Bldg., Grand Rapids
Date of next meeting: April 11-13, 1932.
Place of next meeting: Detroit (Statler Hotel).

MINNESOTA

George D. Estes, President.....911 Medical Arts Bldg., Minneapolis
L. M. Cruttenden, Secretary.....435 Hamm Bldg., St. Paul
T. D. Abernathy, Treasurer.....Rochester
Date of next meeting: February 24-26, 1932.
Place of next meeting: St. Paul.

MISSISSIPPI

D. N. Garner, President.....West Point
J. H. Brown, Secretary-Treasurer.....Newton
Date of next meeting: April, 1932.
Place of next meeting: Meridian.

MISSOURI

W. W. Brown, President.....Frisco Bldg., Joplin
C. W. Digges, Secretary.....Columbia
J. F. McLellan, Treasurer.....Moberly
Date of next meeting: May 16-18, 1932.
Place of next meeting: Joplin (Conner Hotel).

MONTANA

O. A. Kenck, President.....Augusta
J. E. Buehler, Secretary-Treasurer.....Great Falls
Date of next meeting: June 30-July 2, 1932.
Place of next meeting: Bozeman.

NEBRASKA

E. W. Fellers, President.....Beatrice
E. A. Pierson, Secretary.....Federal Trust Bldg., Lincoln
G. L. Spencer, Treasurer.....Sharp Bldg., Lincoln
Date of next meeting: May 16-19, 1932.
Place of next meeting: Lincoln.

NEVADA

Harold E. Cafferata, President.....Reno
Pliny H. Phillips, Secretary-Treasurer.....Reno
Date of next meeting: June 4, 1932.
Place of next meeting: Reno.

NEW HAMPSHIRE

G. A. Staples, President.....115 Main St., Nashua
W. J. Moyles, Secretary.....1061 Elm St., Manchester
W. A. Young, Treasurer.....Concord
Date of next meeting: June 1-3, 1932.
Place of next meeting: North Conway.

NEW JERSEY

Kenneth C. Pruden, President.....44 Church St., Paterson
F. K. Heazelton, Secretary.....223 East Hanover St., Trenton
George H. Griffith, Treasurer.....42 West State St., Trenton
Date of next meeting: April 13-15, 1932.
Place of next meeting: Atlantic City (Hotel Chelsea).

NEW MEXICO

M. J. Moran, President.....Deming
Fred Muller, Secretary-Treasurer.....Taos
Date of next meeting:
Place of next meeting: Albuquerque.

NEW YORK

George Vanderpool, President.....186 State Street, Albany
A. P. Burkhart, Secretary.....57 E. Genesee Street, Auburn
George H. Butler, Treasurer.....Skaneateles
Date of next meeting: May 11-13, 1932.
Place of next meeting: Albany (Hotel TenEyck).

NORTH CAROLINA

Dennis F. Keel, President.....Greensboro
N. P. Maddux, Secretary-Treasurer.....Asheville
Date of next meeting: May 2-4, 1932.
Place of next meeting: Elizabeth City.

NORTH DAKOTA

R. S. Towne, President.....Bismarck
W. S. Shaw, Secretary.....Edwards Bldg., Fargo
L. E. Musberger, Treasurer.....Jamestown
Date of next meeting:
Place of next meeting: Minot.

OHIO

Paul J. Aufderheide, President.....946 Rose Building, Cleveland
Edward C. Mills, Secretary.....255 E. Broad St., Columbus
Harry Cope, Treasurer.....327 E. State St., Columbus
Date of next meeting:
Place of next meeting: Cincinnati.

OKLAHOMA

Oren H. McCarty, President.....Medical Arts Bldg., Tulsa
E. E. Sanger, Secretary.....Yukon
C. R. Ball, Treasurer.....Frederick
Date of next meeting: April 19-23, 1932.
Place of next meeting: Muskogee.

OREGON

H. C. Epley, President.....Salem
F. W. Hollister, Secretary-Treasurer.....Medical-Dental Bldg., Portland
Date of next meeting: February 25-27, 1932.
Place of next meeting: Salem.

PENNSYLVANIA

H. M. Kirkpatrick, President.....Payne-Shoemaker Bldg., Harrisburg
C. W. Hagan, Secretary.....1011 Macon Ave., Swissvale
J. A. Brady, Treasurer.....2108 N. Broad St., Philadelphia
Date of next meeting.
Place of next meeting:

PORTO RICO

Jose Vicente, President.....Box 100, San Juan
J. R. Hernandez Gonzales, Secretary.....Box 1361, San Juan
R. Fernandez Carballo, Treasurer.....Box 3291, Santruce
Date of next meeting: November, 1932.
Place of next meeting: Ponce.

PHILIPPINE ISLANDS

Eladio R. Aldecoa, President.....1742 Rizal Ave., Manila
Hilario P. Perez, Secretary-Treasurer.....Dela Rama Bldg., Manila
Date of next meeting:
Place of next meeting:

RHODE ISLAND

Philip A. Duffy, President.....East Greenwich
Charles J. Smith, Secretary.....146 Westminster St., Providence
William J. McGovern, Treasurer.....830 Park Ave., Auburn
Date of next meeting: Jan. 20-21, 1932.
Place of next meeting: Providence.

SOUTH CAROLINA

T. L. Timmerman, President.....Laurens
N. W. Macaulay, Secretary.....Medical Bldg., Columbia
G. M. Meares, Treasurer.....1507 Main St., Columbia
Date of next meeting: May 23-24, 1932.
Place of next meeting: Greenville (Poinsett Hotel).

SOUTH DAKOTA

William H. Tweedle, President.....Pierre
E. W. Elmen, Secretary.....Sioux Falls
J. W. King, Treasurer.....Aberdeen
Date of next meeting: May 16-18, 1932.
Place of next meeting: Sioux Falls.

TENNESSEE

John J. Ogden, President.....Sterick Bldg., Memphis
E. J. Justis, Secretary-Treasurer.....Exchange Bldg., Memphis
Date of next meeting: May, 1932.
Place of next meeting:

TEXAS

Joseph P. Arnold, President.....1019 Esperson Bldg., Houston
J. G. Fife, Secretary-Treasurer.....Medical Arts Bldg., Dallas
Date of next meeting: May 17-20, 1932.
Place of next meeting: Dallas.

UTAH

T. Fred Hardy, President.....Medical Arts Bldg., Salt Lake
William Wood, Secretary-Treasurer.....1411 Deseret Bank Bldg., Salt Lake
Date of next meeting: First week in June, 1932.
Place of next meeting: Provo.

VERMONT

H. R. Bristol, President.....Bennington
E. B. Jenney, Secretary.....Rutland
Date of next meeting: May 18-20, 1932.
Place of next meeting: Burlington.

VIRGINIA

R. B. Snapp, President.....Winchester
A. M. Wash, Secretary-Treasurer.....Medical Arts Bldg., Richmond
Date of next meeting: May 16-18, 1932.
Place of next meeting: Winchester.

WASHINGTON

William B. Power, President.....832 Medical Bldg., Seattle
A. W. Jeffery, Secretary-Treasurer.....533 Medical Bldg., Seattle
Date of next meeting: July 5-9, 1932.
Place of next meeting: Seattle.

WEST VIRGINIA

C. Ray Sturm, President.....Fairmont
J. E. Herbert, Secretary.....Martinsburg
John S. Stone, Treasurer.....Clarksburg
Date of next meeting: May 16-18, 1932 (Jointly with Virginia State).
Place of next meeting: Winchester, Va.

WISCONSIN

J. F. Mortell, President.....Oshkosh
E. E. Parkinson, Secretary.....104 King St., Madison
H. S. Huxtable, Treasurer.....Mineral Point
Date of next meeting: June 7-9, 1932.
Place of next meeting: Milwaukee (Hotel Schroeder).

WYOMING

P. C. McNiff, President.....Laramie
E. C. Andrew, Secretary.....Hynds Bldg., Cheyenne
Peter Appel, Jr., Treasurer.....Hynds Bldg., Cheyenne
Date of next meeting: June, 1932.
Place of next meeting: Thermopolis.

OFFICERS AND TRUSTEES OF THE AMERICAN DENTAL ASSOCIATION

1931-1932

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Martin Dewey.....17 Park Ave., New York City

PRESIDENT ELECT

G. Walter Dittmar.....59 E. Madison St., Chicago, Ill.

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C. R. Lawrence.....American National Bank Bldg., Enid, Okla.
Sterling V. Mead.....1149 Sixteenth St., N. W., Washington, D. C.

SECRETARY

Harry B. Pinney.....212 E. Superior St., Chicago, Ill.

TREASURER

R. H. Volland.....Iowa City, Iowa

BOARD OF TRUSTEES

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Harry B. Pinney, Secretary, Ex-Officio.....212 E. Superior St., Chicago, Ill.
R. H. Volland, Treasurer, Ex-Officio.....First Nat. Bank Bldg., Iowa City, Iowa
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Edward H. Bruening, '33.....620 City National Bank Bldg., Omaha, Nebr.
Harvey J. Burkhart, '33.....Box 35, East Avenue P. O., Rochester, N. Y.
W. O. Talbot, '33.....Medical Arts Bldg., Fort Worth, Texas
Arthur Cornelius Wherry, '33.....910 Deseret Bank Bldg., Salt Lake City, Utah
James A. Brady, '32.....2108 N. Broad St., Philadelphia, Pa.
Sheppard W. Foster, '32.....849 Peachtree St., Atlanta, Ga.
Frederick H. Lum, Jr., '32.....151 Main St., Chatham, N. J.
C. N. Johnson, '32.....212 E. Superior St., Chicago, Ill.
J. J. Wright, '32.....1218 Wells Bldg., Milwaukee, Wis.